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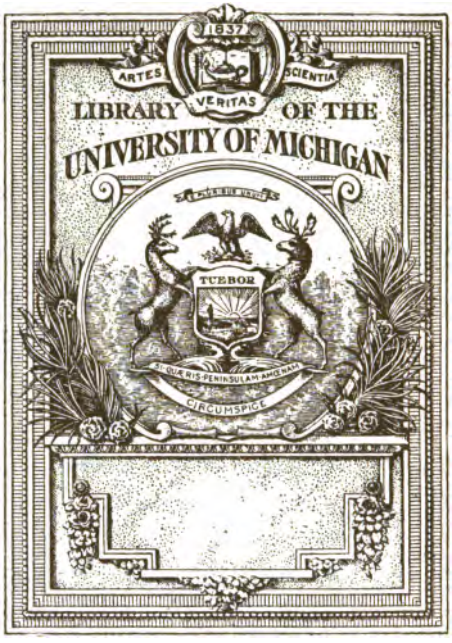
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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL, *CHEMICAL, AND AGRICULTURAL* DISCOVERIES:

BEING

An Abridgment

OF THE

PERIODICAL AND OTHER PUBLICATIONS,

ENGLISH AND FOREIGN,

RELATIVE TO

Arts, Chemistry, Manufactures, Agriculture, and Natural Philosophy;

ACCOMPANIED, OCCASIONALLY, WITH

REMARKS ON THE MERITS OR DEFECTS OF THE RESPECTIVE PAPERS;

AND, IN SOME CASES, SHEWING TO WHAT OTHER USEFUL PURPOSES INVENTIONS MAY BE DIRECTED, AND DISCOVERIES EXTENDED, BEYOND THE ORIGINAL VIEWS OF THEIR AUTHORS.

VOL. I.

LONDON:

PUBLISHED BY J. WYATT, AT THE REPERTORY-OFFICE, 102, HATTON-GARDEN.

1806.

S. Gosnell, Printer,
Little Queen Street, Holborn.

PREFACE.

At no very distant period this country was without a single periodical publication devoted exclusively either to Philosophical objects, or the improvement of Arts and Manufactures, unless indeed the occasional appearance of the Transactions of the Royal Society and the Society of Arts, and a few other similar works, can be so deemed.

In the year 1794, however, the Proprietors of the present undertaking, published the first number of a monthly work, the Repertory of Arts and Manufactures, which maintains a fair reputation at the present hour. That work receiving a high degree of public patronage, and the Proprietors confining themselves chiefly to the insertion of practical papers, others soon followed, both at home and abroad, of a more speculative or theoretic tendency, till at length the number and variety of scientific journals are become so great, as to require, for the conveniency of most readers, a separate work, to serve as a digested index to the whole.

This volume is the fruit of an attempt to that end, wherein the Editors believe will be found, in an abridged form, every article contained in those several publications; with such remarks on many of them as they venture to hope will not be thought insignificant.

Much care has been taken to render these abridgments perspicuous; yet, conscious of the difficulty of this task, the Editors fear they may not always be so satisfactory as the originals: but, references being given to the work from

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which each article has been extracted, the reader has the means of resorting to that source; and if in a foreign language, to the English work, if known to the Editors, in which the translation of that paper is contained.

The observations made by the Editors on many of the papers the Proprietors trust will evince both a desire and an ability to improve the subjects to which they relate. These, however, will not occupy the pages of the work to the exclusion of other original matter.

It would be grateful to the Proprietors to announce the names of the gentlemen who assist in the execution of this work, but the reader will doubtless see an obvious impropriety in it.

In future, it is intended to publish a number every three months: but as the arrival of foreign books is very irregular, it may not always be in the power, though it will be the aim of the Proprietors, to be precise in the day of publication.

The hurry inseparable from a work of this nature will naturally occasion many inaccuracies; the Editors therefore hope for the indulgence of their readers on this head, and will be grateful to gentlemen who may discover any, to point them out, so that they may be corrected in a future volume.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. I.] *January, February, March, April.* [1805.

CHEMISTRY AND MINERALOGY.

Of the Phonolithe; or, Klingstein, of the Germans.

By M. DAUBUISSON.—*Journ. de Phys.*

THE phonolithe is principally remarkable for containing a twelfth part of soda in its composition: it is found in many parts of France and Germany in great abundance. That of Mount Millischau, in Bohemia, analysed by M. Klaproth, contains, in his opinion, soda sufficient to supply all Europe, if any means were found to separate it from the substances with which it is combined.

The circumstance whence this fossil derives its name, is the clear sound it produces on being struck by a hard substance.

Its colour is a greenish grey, varying frequently to a grey, sometimes light, sometimes deep. It is found in great masses, traversed by fissures, which affect a regular direction, and divide it into plates of different thicknesses, and into irregular prisms. Its fracture is dull: a bright light, however, causes somewhat of a reflection like a mother-of-pearl from it. It is scaly: the scales are large, grey, and reddish: in large portions it is schistose. It breaks easily, and separates into plates more or less thick. It has little elasticity, and may be bored without cracking it.

Its hardness rarely is so great as to yield a few sparks when struck with steel.

It is very transparent at its edges.

Its specific gravity is from 25 to 27, that of water being 10.

The action of the air alters its surface, and soon covers it with a whitish earthy crust, which is a property peculiar to it.

Exposed to the action of fire, it loses its water of composition: in a violent fire it melts into a thick glass: at the blow-pipe, it passes into a white or grey enamel.

The substances with which it may be compounded, are basalt, petrosilex, and some species of schists. Its colour, its transparency at the edges, its less specific gravity, and its different result on exposure to fire, distinguish it from basalt. Its compact and scaly transverse fracture, its transparency, and sonorous quality, distinguish it from schist. Its schistose appearance, and particularly the substances found with it, and the circumstances of its position, prevent its being compounded with petrosilex, to which it has a great resemblance in other respects.

Analysis.

The phonolithe of the Mountain of Millischau, in Bohemia, was analysed by Klaproth: that of Mount Or, in Auvergne, by Mr. Bergman.

The following are the results:—

	Bohemia.	*Auvergne.*
Silex	57,25	58
Alumen	23,50	24,50
Lime	2,75	3,50
Oxyd of iron	3,25	4,50
Oxyd of Manganese	0,25	---
Soda	8,10	6
Water	3	2
Loss	1,90	1,50
	100	100

This analysis has a great similarity to that of feldspath, with the exception that the alkali found in this latter is potash. Besides its specific gravity, its hardness, its transparency, and its results from the fire, shew a great analogy, in its nature and composition, to that of the compact feldspath, or petrosilex of Dolomieu.

Sometimes the phonolithe has a greater proportion of iron, in which case its colour is deeper, it is heavier and less transparent.

On Corundum Stone, found in Italy.

By M. PINI, *Inspector of Italian Mines.—Journ. de Phys.*

M. PINI has announced the discovery of this substance in a mountain of Italy. He first saw it among some fossils collected in the department of Serio, by M. Brochi, professor of natural history at Brescia, who at first considered it as a species of feldspath; and, considering that corundum has hitherto been only supplied from far-distant countries, he would have been imprudent to judge otherwise of it: but its colour so entirely resembling some from Madras, in M. Pini's possession, made him suspect this to be the same; and on trial he found he had not been mistaken in his conjecture. The following is the result of this trial.

The corundum of Italy, 1st, cuts the most hard rock-crystal; 2d, It does not fuse by the blow-pipe, either alone or with the addition of borax; 3d, Its substance is formed of laminæ, in different directions; 4th, It is cleavable three ways, and when it is cut in the three directions, its form is a rhomboid, of which the acute angle is 64½ degrees; 5, Its transverse fracture has the brilliancy of diamonds, and reflects the light in the same manner, of which the reflection has almost the colour of silver; 6, Its specific gravity is 3,87, which is the same as that of the true corundum.

This of Italy seems to be the only true species yet found in Europe. That stone, found in Germany, imagined to be corundum, was found to be feldspath or leucolite. That in the British Museum, found on the eastern coast of Scotland, was far from having the hardness proper to this species. That of Chesnut-hill, near Philadelphia, which Mr. Smith announced, was, by Mr. Richard Philips, found to be a fragment of quartz, badly crystallized; that discovered by M. Bournon, at Forez, in France, was, by the Abbé Hauy, found deficient in specific gravity; but this of Italy is deficient in no one circumstance.

If rubies and saphires are of the same genus as corundum, as most mineralogists seem inclined to suppose, it is probable that Europe likewise possesses mines of these precious stones, as it has mines of emeralds, as those of Limoges, discovered by M. Lelievre, counsellor of mines. But these stones will continue to be the rubies, the saphires, and the emeralds of the mineralogists, not of the jewellers, until they are found of a proper transparency, which M. Pini hopes will be the fruit of farther researches.

Of Chemical Combinations.—Journ. de Phys.

CHEMISTRY has a grand point to determine, which is disputed with warmth by the most celebrated chemists.

Have the chemical combinations, which different bodies present, fixed limits? Or do they admit of a certain variety?

Proust thinks they have fixed limits, and he has published many excellent memoirs: iron, for example, can be oxydated, he thinks, but in two degrees.

At the minimum of oxydation, the black oxyd contains oxygen	0,28
At the maximum, the red oxyd contains	0,48
Oxyd of copper contains of oxygen	0,25
Oxyd of arsenic	0,33
Oxyd of lead	0,09
Oxyd of antimony at the maximum	0,30
Oxyd of antimony at the minimum	0,00
Oxyd of tin at the minimum	0,15
Oxyd of tin at the maximum	0,28

But the different metallic oxyds have a great variety of shades. Thus, for example, the oxyds of iron offer a great number of varieties: all those various kinds of oxyds are, according to Proust, but mixtures of the red and black oxyd, with a portion of metal not oxydated, or with other substances.

Combinations of Sulphur.

Proust thinks, in like manner, that the combinations of sulphur have fixed limits. The following are what he assigns them:—

Sulphur can combine itself with iron in two proportions; at the minimum it is but a tenth part of the composition, as in that of ferruginous pyrites, which contains

Iron	90
Sulphur	10

At the maximum, such as are the artificial combinations, the composition contains

Iron	60
Sulphur	40

Sulphur of copper contains

Copper	72
Sulphur	28

Sulphur of antimony contains

Antimony	75
Sulphur	25

The combinations of sulphur with the alkalis and the earths, have limits equally fixed.

Combinations of Metals with Acids.

The combinations of acids with metals, or more properly with metallic oxyds, have likewise fixed limits, according to Proust; so that mercury can combine with muriatic acid but in two different proportions.

The muriate of mercury, at the minimum, produces mild mercury, or calomel.

Muriate of mercury, at the maximum, is corrosive sublimate.

If the two muriates are mixed, a kind is produced, depending on the *quantity* of each sort.

Oxyd of copper, of 25 per cent. oxygen, combines with the marine acid, and forms a salt of a fine grass-green.

If the solution be farther diluted, it changes to a blueish green.

On Palladium and Rhodium. By Dr. WOLLASTON.

And on his Discovery of the First.

To analyse the substance left after the solution of platina, with all possible caution, this metal was freed mechanically, first, as much as possible, from all extraneous matter, and afterwards exposed to a red heat, to expel any mercury that might remain united to it. A small quantity of nitro-muriatic acid was then added, to dissolve adhering gold.

Nearly 2½ oz. of the ore thus prepared, were dissolved in nitro-muriatic acid (diluted for the purpose of leaving as much of the shining powder as possible), and left in a moderate sand heat till saturated.

As much as corresponded to 1000 grains of the ore was precipitated of this solution, by solution of sal ammoniac, and yielded 815 grains of pure platina.

The residual liquor was pricipitated by zinc, and produced, by estimate, between 40 and 50 grains of black powder, which was exposed to the action of dilute nitric acid, with a gentle heat to extract copper and lead, and the remainder well washed and digested in dilute nitro-muriatic acid, which took up all but about 4½ grains.

Twenty grains of common salt were added to the solution, and the whole evaporated to dryness, and then well washed with alcohol, which carried off the soda-muriates of platina and palladium, and left that of rhodium free.

This salt of rhodium was dissolved in water, crystallised, the crystals again dissolved; then divided, and one part precipitated by a piece of zinc; the other part tried with sal ammoniac, prussiate of potash, hydrosulphuret of ammonia, and carbonated alkalis, gave no precipitate: but when a solution of platina was added, a precipitate was immediately thrown down of a yellow colour; which proves, that the metal contained in the salt, is neither platina, nor the colouring matter of its red precipitate. Pure alkali, likewise, threw down from it a yellow precipitate, soluble by excess of alkali, and by all the acids tried.

The solution of this oxyd in muriatic acid, did not crystallise, and sal-ammoniac, nitre, or marine salt, caused no precipitation, but formed triple salts, which were not soluble in alcohol.

The nitric solution did not crystallise, did not stain silver, left a metallic film on mercury, which did not amalgamate, and was precipitated by copper and other metals.

The portion of the rhodium precipitated by zinc from what remained after the washing with alcohol before mentioned, appeared in a black powder, weighing two grains: exposed to heat with borax, it acquired a white metallic lustre, but did not fuse. With arsenic, and with sulphur, however, like platina, it became fusible. These substances may be driven from it by heat, but it does not then become malleable.

It unites with all metals tried, except mercury; with six parts of gold, one of rhodium may be united, so as in no wise to differ in colour from pure gold. It is, however, more difficult of fusion: the effect of platina, on the contrary, is to destroy the colour of gold so much, that a fifth of platina whitens the whole. Palladium also has the same effect as platina in this respect.

In an alloy of silver or gold, exposed to either nitric or nitro-muriatic acid, the rhodium remained untouched. But one part rhodium to three of bismuth, copper, or lead, dissolved completely in a mixture of two parts muriatic acid, with one of nitric.

The specific gravity of rhodium exceeded 11.

Palladium.

The alcohol, in which the evaporated matter was washed, (after the addition of the sea-salt before mentioned), contained the soda muriates of platina and palladium: the platina was first precipitated by sal ammoniac, of a deep red colour; which became grey on exposure to heat.

To the remaining solution, well diluted, was added prussiate of potash, which threw down a copious precipitate of a deep orange, which afterwards changed to a dirty bottle-green.

This precipitate, weighing 12¼ grains, being heated, left a metallic residuum of 7 grains; with borax, it acquired a metallic lustre, but did not fuse; with sulphur, it fused readily into a globule, which floated on mercury.

The whole quantity was then treated in the same manner, and purified by cuppellation with borax, till it cooled with a bright surface. The sulphur was expelled by heat; the matter then became spungy and malleable, and weighed then near five grains: and this formed palladium.

Palladium totally differs from platina in several instances: Muriate of tin changes a dilute solution of platina from a pale yellow to a blood red; on the contrary, it first renders that of palladium opaque, by the formation of a brown precipitate; but, mixed in such portions as to remain transparent, its colour changes to a beautiful emerald green.

The triple salts formed by palladium, with the alkalis, are much more soluble than those formed by platina, and differ entirely from them in the colour and form of the crystals.

The soda muriate of palladium is a deliquescent salt; that of platina forms permanent crystals.

The specific gravity of the two metals is also different.

The Discovery of Palladium explained.

The former part of this extract is contained in the Philosophical Transactions for 1804. In March 1805, Dr. Wollaston published a letter in the Philosophical Journal, acknowledging that he was the person who left a quantity of this metal for sale with Mrs. Foster, and also the author of certain communications to that Journal on this subject. Dr. W. accounts for the large quantity of palladium left, by his having purchased a proportionable quantity of platina, with a design to render it malleable. The leaving it at Mrs. Foster's with the advertisement accompanying it, but concealing the discoverer's name, is accounted for by his wishing to farther examine certain appearances, which could not be then explained by the existence of that metal alone, (but have since been so by the discovery of rhodium, also being combined with platina,) and at the same time to secure his right to the priority of discovery.

The chemists, who were so positive that palladium was a mixed metal composed of platina and mercury, have some degree of ridicule thrown on them by this explanation of the discovery of the new metal: and if the Doctor had designed to afford himself some amusement in this way, he could not have taken a better method, though it is by no means supposed this was intended.

Analysis of Lac, and Observations on it.

By CHARLES HATCHETT, *Esq.—Phil. Trans.*

LAC, the produce of the insect coccus or chermes lacca, is brought from India in four states.

Stick lac is the substance as formed by the insect. Seed lac is most probably the former reduced to grains, after having its colouring matter extracted by the Indian dyers, by pounding and boiling it to form a dye. Lump lac is seed lac liquefied by heat, and formed into cakes.

Shell lac is formed from stick lac liquefied, strained, and formed into thin transparent laminæ, by a particular process.

The greatest quantity of lac comes from Asam. Water extracts the colour from lac: alcohol dissolves much of it clear, if cold. Ether affects it very little. Of the acids, nitric acid alone by time and care dissolves it entirely. The solution is turbid; and on diluting, it deposits wax.

Borax one-fifth renders lac soluble in water, either mixed previously with it, or dissolved first in the water: 20 grains borax to 100 lac, and 4 oz. water, is the best proportion for this solution: a heat near boiling must be used, and the evaporation replaced by more water. This forms a sort of soap, that when dry is not easily affected by water: which makes a good vehicle for colours or varnish.

Soda and carbonate of soda dissolve it also, and the carbonate will do so when a smaller portion than one-fifth is used: these solutions are sooner effected by damp than that made by borax.

Pure ammonia and carbonate of ammonia act only partially; attack the colouring matter readily, but do not completely dissolve the lac.

Analysis of Lac.

100 parts Lac yielded

	Stick lac.	Seed lac.	Shell lac.
Resin - -	68	88,50	90,90
Colouring extract	10	2,50	0,50
Wax - -	6	4,50	4
Gluten - -	5,50	2	2,80
Extraneous substances	6,50	- -	- - -
	96	97,50	98,20

The proportions of the substances which compose the varieties of lac are subject to considerable variation: thence it should be stated, that lac consists principally of resin mixed with certain proportions of a peculiar kind of wax, of gluten, and of colouring extract.

The colouring extract is acted on but partially by water, which leaves an insoluble residuum.

Alcohol acts but slowly on it, and dissolves less of it than water, and the colour produced is not so beautiful. It is insoluble in sulphuric ether.

Sulphuric acid, nitric acid, and acetic acid, dissolve it readily: acetous acid not quite so well, and muriatic acid only in part.

Lixivia of potash, soda, and ammonia, act powerfully on it, and form solutions of a deep purple colour.

Pure alumina does not produce any immediate effects; but on addition of a few drops of muriatic acid, a beautiful lake is formed.

Muriate of tin produces a fine crimson precipitate, when added to the aqueous solution: and the solution of isinglass forms a precipitate of the same colour with it.

The wax is so much of the nature of myrtle-wax, that Mr. Hatchett considers them as the same substance.

The resin is completely soluble in alcohol, ether, acetic acid, nitric acid, and lixivia of soda and of potash.

The gluten resembles much that of wheat.

Uses of Lac.

The natives of India use this substance for many purposes: they form it into beads, rings, and various other ornaments.

With shell lac, dissolved in water by borax, they form ink, by the addition of ivory-black, not easily affected by water, when dry.

Varnishes are likewise formed from it.

Lakes for painters, and dyeing materials, are likewise furnished by its colouring matter.

The resinous part is employed to form grindstones, by melting it, and mixing it with about three parts sand. For lapidaries, the powder of corundum is used instead of sand.

Mr. Hatchett mixed various colours with the solution of lac by borax, which, when dried on paper, could not be removed by a wet sponge, without destroying the paper.

The action of alkalis and acids on this substance, and Mr. Hatchett's other experiments, fully prove that resins, gum resins, and balsams, are powerfully acted on by the alkalis, and some of the acids.

Mr. Hatchett proposes the farther use of lac for pigments, and for dyes: as many colours, especially the metallic, when dissolved in acids, may be precipitated combined with resin, by adding the former to the alkaline solutions of the latter, and thinks it probable that the famous vehicle for colours, of the Venetian school, may have been some kind of resinous solution, formed in this way by means of borax, or the alkalis.

Medicine also may derive some advantage from the acid and alkaline solutions of resinous substances.

On the Transition from the Vitreous to the Stoney Texture of melted Basalt. By GREGORY WATT, *Esq. Phil. Trans.—With some Observations on the Crystallisation of Glass.* By M. DARTIGUES. *Ann. de Chim.*

Mr. Watt repeated Sir James Hall's experiments on the regulated cooling of melted basalt, by fusing in a reverberatory furnace about seven hundred weight of amorphous basalt, called Rowley rag. It melted readily with less than half the fuel that would be necessary to melt an equal quantity of pig-iron. It formed a liquid glass, rather tenacious; some taken from which, on cooling, retained the characters of perfect glass.

The mass was let to cool gradually by covering it with sand, and regulating the fuel so as to consume away slowly. It was eight days before it was cool enough to remove, and then possessed considerable internal heat.

The glass of basalt, when cooled with a certain degree of slowness, first developes its tendency to arrangement by the formation of minute globules in its mass, of less than a tenth of an inch in diameter. In general these are so near as to touch before they have attained any considerable size: so that as the process advances in cooling, they adapt their form to their confined situation, fill up every interstice, and thus form prismatic arrangements. In this state the fracture exhibits minute conchoidal appearances, which display the form of each globule.

A more slow degree of cooling occasions the globular masses to form at greater distances, and thus to be larger; in the experiment some were produced two and a half inches in diameter; these were radiated with distinct fibres.

The matter passes from this fibrous state, in cooling, first to a more compact stoney texture, possessing great tenacity, of somewhat inferior hardness to the glass from which it was formed, and considerably magnetic, opaque, and of a greenish black colour: the surface of the compressed globules acquire a rusty hue, by which they may be traced on the fracture.

A continuation of the temperature favourable to arrangement causes the texture of the mass to become more granular, and its colour lighter; and finally it becomes pervaded by thin crystalline laminæ, which intersect it in every direction, and form projecting crystals in the cavities. Its magnetism is then increased, and seems to have some polarity, and its specific gravity is greater than before.

With a certain degree of cooling, the mass exhibits the appearance of jasper, and loses all prismatic division: this Mr. Watt thinks takes place immediately after the first state described, of very minute globules.

The globules are formed of concentric coats, besides being radiated; from which Mr. Watt accounts for the divisions observed across the substance of the prisms.

From these facts, observed in the experiment, Mr. Watt accounts for the formation of columnar basalt.

The whole of a bed of this substance having been in fusion, would form gobular masses, such as those described, at greater distances, and of course of greater size as the cooling was more slow; and these again would become prismatic columns when arrived at the full size that their proximity would admit. The transverse separation of the columns into joints, he accounts for, by the formation of concentric coats in the globular masses, of which each joint would exhibit the thickness of a single coat.

The appearances of columnar basalt confirm this idea by many circumstances: the columns are always smaller, and more numerous of course, at the extremities of the bed, above, below, and all round, and larger in the middle.

They are covered by an amorphous mass of the same substance, which cooled too quick to form any arrangement: and the general disposition of basalt to exhibit globular masses on decomposition, farther proves the justness of the theory.

Mr. Watt observes, that a variety of different forms may be produced by the same composition cooling with different degrees of slowness; and that thus many stones apparently different, have the same origin. This is confirmed by the appearances exhibited by lava, in which may be observed every step of the passage from the vitreous to the stoney, from that to the porphyretic, and lastly, to the granite state. That fluidity is not an indispensable requisite for the crystallisation, Mr. W. gives a proof in the well-known formation of what is called Reaumur's porcelain, from glass vessels in a temperature much below what is necessary for their fusion, which proceeds from a regular arrangement of the molecules of the glass, in every respect similar to crystallisation. Like that of the substances before recited, this crystallisation of glass passes through various gradations; and, if the requisite temperature is continued, the fibres disappear, and it becomes fine-grained and almost compact.

Mr. Watt mentions a strong analogy between solution and fusion: thus ice and soda have no more action on each other than soda and quartz; but, raise the temperature of the ice, and it unites to the soda: and a sufficient increase of temperature will also unite the quartz to soda.

Mr. Watt considers the mode of arrangement which takes place in basalt, as independent of the question of its igneous or aqueous origin, and equally applicable to both: he mentions instances of various other rocks, affecting the columnar form, as well as basalt. Lava is often found in this state; columns of porphyry are not rare, and are found near Dresden, several feet in length, and not more than two inches in diameter.

Columns of petrosilex compose a very large portion of a mountain near Conistone Lake: very perfect quadrangular prisms of argillaceous schistus are found near Llanwrst: rubble-slate assumes the columnar form at Barmouth. The limestone, near Cyfortha, in Glamorganshire, is divided into very acute rhomboidal prisms: even the sand-stone of the same district is not unfrequently columnar: and one of the beds of gypsum at Mont Martre, is distinctly divided into pretty regular columns. Sand-stone, clay, argillaceous iron ore, and many other substances, become prismatic by torrefaction: and the prisms of starch, formed in drying, have often been considered as illustrative of basaltic formations.

Many of these substances are allowed to be of aqueous formation; and this is not the only instance wherein substances of this nature resemble the circumstances observed in the formation of basalt.

Calcareous stalactites are at first fibrous, a continuation of the process causes the fibrous structure to disappear, and the stalactite becomes irregularly spathose.

The irregularities afterwards vanish, and it becomes perfect calcareous spar, divisible into large rhomboids, with the form peculiar to that mineral, and all the gradations may be observed in the same specimen: a considerable part of the coast near Sunderland is formed of limestone spheroids; in some of which the radii still exist, while others have passed to the compact state.

The observations made by Mr. Watt, relative to the porcelain of Reaumur, are fully confirmed by what has been published on this subject, by M. Dartigues, an eminent glass-manufacturer in France, who has proved, that the formation of this substance is not caused by any thing resembling cementation, to which it was usually attributed, or in any wise depended on the substances in contact with which it was heated, but was entirely the effect of crystallisation, which he has traced through various stages.

In this crystallisation of glass, first, a blueish colour appears, mixed with the natural green of the glass; secondly, after this, the glass loses its transparency; a dirty white precipitation is formed in its substance; its colour becomes deeper, by degrees, and at length it resembles grey horn. Lastly, in the midst of this horn-like substance, very distinct crystals are formed, consisting of nodules, composed of small needles, all converging towards the

centre. In this state, it is no longer glass, but a crystallisation, entirely resembling that of mineral substances.

This is seen most remarkably, in the substance found in the large cavities formed in the bottom of glass furnaces, by the action of the fire.

The more compounded the glass, the more readily are these crystals formed in it; and the simple glasses composed merely of silex, with the precise quantity of flux necessary for its saturation, admit of this change with difficulty; hence, common bottle-glass is easily crystallised; and white flint-glass is scarcely altered in a very long-continued fire, but by becoming more hard and yellow.

A new Process for preparing Black Oxyd of Iron (Martial Ethiops).

By MM. TRUSSON *and* BOUILLON LAGRANGE.—*Ann. de Chim.*

A variety of methods have been published for preparing martial ethiops, from the time of Lemberg, who first discovered them; but all of them more difficult and troublesome, and more variable in their result, than this, and none producing an article so unalterable by the air, and so advantageous for medicinal preparation.

Process.

Dissolve purified sulphate of iron, in eight parts of boiling distilled water, and filter.

Dissolve one part of chrystallised carbonate of soda, in from eight to ten of water, and filter.

Pour, by degrees, the solution of soda into that of the sulphate of iron: the first precipitate is green; afterwards the colour is darker, the more there is decomposed.

The precipitate must be levigated till the water from the levigation produces no alteration in Gallic alcohol, or muriate of barytes. Dry it then with a gentle heat; and add to each ounce of this substance three drachms of acetic acid, which occasions a slight effervescence: mix it well, place it in an iron or stone retort, in a reverberating furnace, adapt a tube and tubulated retort, provided with a curved tube immersed in water. All the crevices and joints must be very carefully luted. Heat by degrees, so as to produce a very powerful heat towards the end of the operation: for half a pound, it ought to be continued almost two hours.

The liquor which passes over, precipitates lime water, and carbonic acid is disengaged during the process.

In the retort will be found a bulky matter, of a beautiful black, pulverulent, and very soft to the touch.

Ethiops prepared in this common way, imbibes much oxygen, which causes it to turn brown: but this does not alter: some kept for sixteen years, in a vessel carelessly covered, was found to be in no way different from that recently prepared.

This black oxyd exposed to heat, turns brown, and afterwards red. The colour is more brilliant than that produced by the ordinary ethiops in similar circumstances.

Sulphuric acid, when cold, has little action on this oxyd; but, with heat, causes it to become red, and afterwards dissolves it entirely.

Prussiate of potash and gall nuts turn the solution to a dark blue.

Muriatic acid rapidly dissolves it.

Nitric acid dissolves it also, after exposure to heat for some time.

In medicine, boluses prepared with it, are very black, easily made smooth, dissolve readily in water, and have a sweetish astringent taste, and leave little insoluble matter on solution.

The martial tinctures, denominated tartarised, are prepared by this oxyd in much less time.

Crystals of chalybeate tartar, prepared from it, are of a fine golden yellow, and dissolve in water without forming any precipitate.

It likewise forms a substitute for iron filings, with the tartaric or any other acid.

Examination of M. Kind's Artificial Production of Camphor: By MM. Boullay, Cluzel, *and* Chomet.—*Ann. de Chim.*

The method of preparing camphor artificially, discovered by M. Kind, was afterwards examined by M. Trommsdorf, who reported favourably of it, which induced the Society of Pharmacy to depute MM. Boullay, Cluzel, and Chomet, to repeat the experiment.

Their apparatus was the same as M. Kind's, and consisted of a tubulated retort, and two woulf bottles with their usual tubes of safety and communication.

Four pounds of marine salt and two of concentrated sulphuric acid were introduced into the retort.

Four pounds of very white oil of turpentine were poured into the first bottle, and two pounds of distilled water into the second bottle: fire was applied to the retort, and gradually augmented till the entire disengagement of the muriatic gas, which was totally absorbed by the oil, which became at first of a citron colour, and gradually grew more brown towards the end of the operation: it retained its transparency, grew very hot, and augmented in volume about one tenth

Left to itself for twenty-four hours, it formed a mass of irregular crystals, from which ran a brown liquor. When dried in absorbing paper, this crystalline matter was very white, and weighed near twenty-four ounces. The liquor yielded more crystals, on farther exposure to cold, first in a cellar, and afterwards artificially lowered below 0, during several hours; these weighed two ounces more. This brings the proportion to nearly seven and a half ounces of camphor to one pound of oil of turpentine.

Distilled water rendered this camphor of a beautiful white, and removed its acid odour, but not that of turpentine. Water mixed with a fiftieth part of carbonate of potash, deprived it of much of its first odour.

Three portions mixed with equal quantities, one with charcoal powder, another with dry ashes, and a third with lime, and sublimed from them in small glass alembics, became very pure, and formed needle-shaped crystals in the capitals: thus purified, it lost all odour of turpentine, and retained only that of camphor, but weaker than camphor of commerce.

Oxygenated muriatic acid gas produced no camphor, on being tried with the same oil.

Muriatic gas, tried with essential oils of lavender and rosemary, rendered them black and heavy, but gave no precipitation nor crystals.

This camphor differs from laurel camphor in its taste, which is not so bitter; in its odour, which is less penetrating; and in the effect produced on it by the nitric and acetic acids, the first of which dissolves it by a reciprocal decomposition; the latter not at all; while both dissolve common camphor rapidly.

The examiners recommend it much for medicinal experiment.

Analysis of the Topaz. By M. VAUQUELIN.—*Ann. de Chim.*

M. VAUQUELIN has made a new analysis of the topaz, of which the results are different from those which he made before. M. Klaproth first announced the discovery of fluoric acid in this precious stone, which induced M. Vauquelin to repeat his experiments; as in his first analysis the result was only 68 alumine, and 31 silex, without any appearance of any other matter: his second trial produced the following results:

	Topaz of Saxony.	Topaz of Siberia.	Topaz of Brazil.
Silex	29	30	28
Alumine	49	48	47
Fluoric acid	20	18	17
Iron	—	2	4
Loss	2	2	4
	100	100	100

He attributes the difference in his former analysis to his using muriatic acid in the process: in this last he used sulphuric acid, which, from its strong combination with the alumine, admitted of a heat sufficient to drive over the fluoric acid, which the former would not permit, without risking its decomposition.

The most remarkable circumstance noticed by M. Vauquelin in this analysis, is, that it is extraordinary that a combination, in which there is from 18 to 20 per cent. of fluoric acid, should be so hard and infusible; when all other known combinations, of which this acid forms a part, are so soft and so fusible.

Method of making Sal Ammoniac, different from that in common use.—Ann. des Arts, &c.

M. RUCKERT has a manufactory of sal ammoniac near to Vienna, in which he uses a process different from that customary in the Levant, and in the *ci-devant* Liege. It is founded on the laws of double affinity; whence results the reciprocal decomposition—first, of sulphate of lime, by carbonate of ammoniac; and, secondly, of sulphate of ammonia, by muriate of soda.

To perform this operation, the ammoniacal liquor obtained from the distillation of animal substances, or other matters employed for this purpose, after being separated from the empyreumatic oil, is thrown upon gypsum, broken into small pieces, till effervescence ceases, and the mixture well stirred up; this causes a double decomposition. The sulphuric acid of the gypsum quits its base of lime to unite with the ammoniac; and the carbonic acid, separating from this latter, partly unites to the lime of the gypsum, and the rest flies off with effervescence.

The carbonate of lime so formed, being very little soluble, falls to the bottom, and the liquor is poured off, retaining sulphate of ammoniac in solution, which is obtained in crystals from it, by evaporation.

The sulphate of ammonia is then mixed with a proper quantity of marine salt, and placed in fit vessels for sublimation; when, on application of sufficient heat, the marine acid and the ammonia, both volatile substances, fly off and unite to form the sal ammoniac, which adheres to the top of the subliming vessel; while the sulphuric acid and the soda, being more fixed substances, remain below in combination and form rough sulphate of soda; which is afterwards decomposed in this manufactory, by means of lime and charcoal, to obtain from it the soda.

As the ammoniacal liquor, when drawn off, contains a considerable portion of empyrumatic oil, united to it in the state of soap, after its separation from all the oil that is found distinct

from it, it is not possible to determine the proportion of the sulphate of lime, that should be put to the ammoniacal liquor, to saturate all the ammoniac with the sulphuric acid: but this may be nearly decided by trial; and besides, there is no injury from a little excess of this substance, as the part not decomposed is not soluble, but in a very small degree.

Wenzel has determined, that, sulphate of ammonia contains 168,75 of ammonia, and 240 sulphuric acid; that marine salt contains 286 soda, and 240 of marine acid; and that sulphate of soda contains 190,66 soda, and 240 sulphuric acid: from which data it is concluded that the proper porportion of sea-salt and sulphate of ammonia is 340,66 of the first, to 408,75 of the latter. There will be a small excess of the volatile alkali in this combination, which may, if thought fit, be diminished by decreasing the quantity of sulphate of ammonia, and substituting a little alum, or Epsom salt, in the mixture which is submitted to sublimation.

If this loss of ammonia be neglected, the produce may be easily calculated: 599 ½ pounds of sulphate of ammonia will in this way produce 446,6 of common sal ammoniac; and there will remain 586,66 pounds rough sulphate of soda in the apparatus, which will produce 1335 pounds crystallised Glauber salt, as it absorbs water in crystallising in the proportion of 134 to 106 of the rough salt.

Observations.—This method of manufacturing sal ammoniac, though new to the French author, has from good information been long practised in this country. Besides the advantages pointed out in the original paper, another of more consequence is to be added, that the calcareous matter left after separating the saline liquor, is found to be a most excellent manure; as indeed might be conjectured from the quantity of animal matter, which must remain united with it.

It is to be regretted that the valuable manufacture of this article is likely soon to be totally transferred from this kingdom to the Continent, from the effect of a very injudicious excise laid on the sulphate of soda, produced in it, aided by the extreme rigour of officers on this occasion. Some manufactories have been already entirely destroyed, and the most eminent of the proprietors of others are so harassed by vexatious suits, that it is to be expected they will soon turn their capitals into other channels. Chemical manufactures, of all others, will least bear excise, because many of them are worked according to secret processes, which, if made public, must pass into other countries; and the greatest part of the profits cease, together with the export. It is thus the Dutch still retain certain valuable manufactures in this line exclusively, because their processes are not publicly known. The introduction of excise officers into manufacturing laboratories, it is evident, must put an end to all

secrecy of operation: and as there are several chemical processes which interruption will extremely injure, and others which it may totally destroy, and as on the whole they in general are of a nature in which interference of others is most peculiarly vexatious, in all probability, if the excise be extended to manufactures of this nature, it will eventually put a stop to most of them, and greatly injure the revenue by causing thereby to cease the duties which at present arise from the exports and imports to a large amount, now depending on the chemical trade of Great Britain.

A small inaccuracy appears in the statements of the products of the sal ammoniac manufacture here described. The amount of the crystallised sulphate of soda seems rated too high, as no allowance is made for waste, the casual introduction of insoluble matters into the rough uncrystallised sulphate of soda, or what will remain in the mother water after crystallisation.

On the Sulphate of Copper, with a Minimum of Acid, found in Peru.
By Professor PROUST.—*Journ. de Phys.*

M. PROUST observes, that he had before stated, in the *Annales de Chimie*, tom. 32, that when sulphate of copper experiences a reduction of its acid by potash, it is changed, in a manner similar to what happens to other salts, into a second species of sulphate of copper, which differs from the first by being entirely insoluble.

This sulphate, with a less portion of acid, is likewise found naturally: the common sulphate experiencing a similar reduction of acid, in the bosom of the earth, in meeting with fossil carbonates may produce it; and it is thus that the specimen from Peru ought to be considered.

Native sulphate of copper, with a minimum of acid, is a combination of a pulverulent consistence, and a green colour; while that saturated with acid, or the common kind, is perfectly blue. It is mixed with various portions of a sand, sometimes ferruginous: some of it has the hardness of a soft stone; and other parts crumble between the fingers; others are argillaceous, and possess more firmness and hardness: their green colour is of a clearer tint than the sandy muriates of Peru.

Boiling water does not dissolve an atom of these sulphates, as is proved by sulphurated hydrogen, the most certain re-agent to detect the least traces of copper. A little sulphate of lime is found united to it; a minute portion of red oxyd of iron also appeared in its analysis, but both in extremely small quantities.

There are four species produced by the union of oxyd of 25 per cent. oxygen with sulphuric acid and water: with dry sul-

phuric acid it produces a white opaque combination, which dissolves in water with heat: this sulphate, in distillation, gives a vapour that condenses into oil of vitriol, as soon as it mixes with the humidity of the air.

Secondly, the white sulphate, as soon as it is dissolved in water, assumes a beautiful colour, and produces rhomboidal crystals, on evaporation, and is then the common blue vitriol. These crystals contain 36 lb. of water to the hundred weight; which water solidifies itself with the other elements of the sulphate. From this circumstance, M. Proust thinks, with M. Chenevix, that this sulphate is only a solution of the hydrate of copper in the sulphuric acid, since all its difference from the white sulphate is entirely owing to the water.

Thirdly, on saturating a solution of the common sulphate with potash, a green heavy precipitate is produced; which, washed and dried, may be boiled in water for any length of time, without dissolving it, or changing its colour.

The sulphate, with a minimum of acid, may also be obtained, by mixing the fresh hydrate, or carbonate, with the common sulphate.

At a heat above boiling water, the minimum sulphate passes from green to a brown colour: this being thrown into water, a part of it, consisting of white sulphate, produces the solution of blue sulphate, which, left on the brown, restores to it again its green colour.

This M. Proust thinks is caused by a part of the green oxyd absorbing the acid, which the heat separates from the other part, and, being thereby converted into white sulphate, with water produces the blue, which again parts with some of its acid to re-convert the brown to the green oxyd.

Fourthly, the hydrate is a combination of the oxyd with water. M. Proust thought, first, that this was formed at the moment when the oxyd abandoned its solvent; but, afterwards, was of the opinion of M. Chenevix, that this combination existed in the sulphate, and that the alkalis only separated the acids from it.

The hydrate of copper has a very distinct character when perfectly pure; its solutions do not cause a change in those of barytes, or in nitrate of silver: it is never pulverulent, but in a brittle mass, like Prussian blue, and its true tint of colour is that of a deep Turquoise.

M. Proust, from observations on this and other hydrates, is now decidedly of opinion, that there are not only metallic hydrates, but alkaline and earthy also. If oxyds can form those combinations with water, doubtless substances which attract it infinitely more form them also. For these reasons he thinks that slaked lime is a hydrate of lime, that crystals of barytes are hydrates of barytes, and that those of soda and potash are hydrates likewise.

Hydrate of copper has a strong taste, while the sulphates, the nitrates, the acetites with a minimum of acid, and the carbonates, have very little taste. This makes it coincide with the alkaline

hydrates, whose taste is not diminished by the combination with the water; from which he infers, that nothing can prove more that it does not draw any of its properties from the acid, than the strong taste which distinguishes it from the salts just mentioned. In fine, he informs us that the great facility with which hydrate of copper changes its state, and loses its colour, by a mild heat and by light, has prevailed on chemists to hesitate to admit it as a distinct substance: but the hydrates of nickel and cobalt, in which the oxyds have stronger affinities than in that of copper, since they resist the action of light, of alkalis, and of boiling water, will, M. Proust hopes, dissipate the doubts which have been formed of the possibility of this kind of combination.

M. Berthollet the younger has published some experiments, which, in his opinion, tend to prove that M. Proust has been mistaken in his notions relative to hydrates. M. Berthollet states them to be salts, with a still less degree of acid than those which M. Proust has named the salts with a minimum of acid, and that, in fact, they are the real salts with a minimum of acid.

M. Proust opposes M. Berthollet rather warmly. His principal arguments are, that hydrates can be prepared without an acid, by black oxyd of copper, in solution of sal ammoniac; that oils dissolve oxyd of copper without any acid being contained in them; that hydrates unite to all the acids readily, even to carbonic acid, which is contrary to what would happen were it a sulphate, and the repetition of what has been already inserted relative to the hydrates of nickel and cobalt. Some of M. Berthollet's experiments he positively asserts to be impossible, and others very erroneous, and accuses him of misquoting authorities, by the advice to him with which he concludes his paper on the subject, which is, that he should use in future more precision in his experiments, and exactness in his citations.

M. Proust, in his answer to M. Berthollet, mentions the following facts, which may be useful to be known, for particular purposes, by those who are unacquainted with them:—that the sulphate of copper and the nitrate, with a minimum of acid, verdigris, the native and artificial muriates, cendre blue, the carbonate, &c. all yield to potash both their acids and hydrates. Potash, tinged with hydrate of copper, throws down the hydrate on being mixed with water, and all the oxydo-alkaline solutions follow the same law. Slaked lime, shaken in a bottle with carbonate of copper and water, produces a fine cendre blue, in about twelve hours; after which last he states, that as lime deprives potash of its carbonic acid entirely, and potash is one of the strongest attractors of acids known, that it is impossible that it should not have the same power over an oxyd, and that oxyd possessed of the weakest attraction of any.

On the White and Green Muriates of Copper.

By Professor PROUST.—*Journ. de Phys.*

THE oxyd of copper, of 25 per cent. oxygen, prepared directly, or separated from acids in combination with it, on being mixed with muriatic acid, forms a salt of a beautiful grass green, which passes to a blueish green on adding much water to the solution. When this muriate is, by distillation, brought to crystallise, it congeals rapidly in a filamentose mass, of a fine green: in this state a careful distillation carries off its water of crystallisation, and its colour also, but does not occasion the least decomposition: it then assumes a colour resembling cane or tobacco of Seville; but, on again acquiring humidity, even from being breathed on, it re-assumes its first tint.

Water has hitherto been considered as merely contributing to the bulk and form of crystals; but now it must be allowed a more extended operation, if attention be paid to its effect in the colour of salts.

A heat a little superior to that which deprives this muriate of its water, causes oxygenated marine acid to pass off in thick yellow vapours, which should be caught in a recipient containing potash, or they will be very troublesome. As this acid goes off, the muriate enters into fusion: as soon as the gas ceases to pass, the retort should be left to cool. The mass at the bottom is of a dirty white, occasioned by some of the muriate which has not participated in the disoxydation, which is easily separated from the rest, by first filling the retort with water, and leaving it in that state for a couple of days; in which time the muriate softens without dissolving, but purges itself of the green muriate: secondly, by pouring the water gently off, so as not to carry away any of the white muriate, and replacing it with some liquid carbonate of potash; the retort is then to be stopped with wax, and shaken, from time to time, for some days, until the mass becomes divided, and converted into a powder resembling in colour the golden sulphur of antimony. This is washed by filling the retort two or three times with water, and afterwards dried in the retort itself. The use of the carbonate of potash, instead of pure potash, occasions the solution of all the black oxyd, formed by the undisoxydated muriate *(le muriate non-disoxidé)*, and deepens the colour of the liquor to a fine blue, but dissolves nothing of the yellow oxyd. If this last be dried in the open air, it quickly forms black oxyd, which alters both its colour and its purity.

The yellow oxyd contains, in the hundred, 14 of oxygen, the black contains 20; or, in other words, if copper condenses 25 per cent. of oxygen for its maximum, it condenses but 16,3 for its minimum.

If green muriate be concentrated on the filings of copper, its colour is changed to a brown; and a portion of white oxyd is formed by the participation of the oxygen. It was attempted in this way to change the whole of the green muriate into white; but the last parts of the first resisted too strongly the change.

To prove the inferior oxydation of the white muriate, its following properties are related. If yellow oxyd, in a glass phial, be covered with muriatic acid of from 8 to 10 degrees, and the mixture shaken for a moment, the oxyd will be changed directly into a white powder, or muriate, of which a part remains in solution. But if the yellow oxyd has been dried too long, one part of it will yield its oxygen to another, and its solution, as above, by this cause be of a green colour. This transmission of the oxygen of one part to another becomes more perceptible if the fire be urged to a certain point; then the oxyd becomes brown, and ends in being converted into a mixture of black oxyd and dust of copper.

To procure, for the following experiments, a solution of white oxyd pure, if thought proper, (for it is not absolutely necessary), the solution may be poured from the white oxyd, and replaced by fresh marine acid, which will continue to dissolve it.

This solution attracts oxygen from the air with extraordinary force, as may be perceived by the pressure on the stopper, and the change of colour to a feuille-morte brown, which increases rapidly as the phial is often opened.

A few drops of the solution of white oxyd precipitates in an instant a diluted solution of gold; that of the green muriate precipitates nothing.

With crystallised prussiate of potash a white flaky precipitate is produced, which the accession of air, or a few drops of oxygenated marine acid, causes to assume a purple colour, the common tint of the ordinary prussiate, with a base of 25 per cent.

Diluted Prussian blue it instantly discolours.

The red sulphate of iron, dissolved in alcohol, is reduced by the above solution to a green sulphate.

The molibdic acid passes to a blue, as by the muriate of tin.

The nitrate of mercury, with the base at its minimum, is changed into mild mercury.

With the juice of cochineal, there is no colour produced but what is caused by the marine acid, while the green muriate causes an abundant violet lake.

M. Proust concludes this paper with the following observations.

On the green insoluble Muriate of Copper, with a minimum of Acid.

This muriate, either native or artificial, is perfectly insoluble in water, as is proved by the test of sulphurated hydrogen: on

burning coals, it does not exhale any acid, but a disagreeable metallic odour, which it is not good to respire. This vapour, condensed on the sides of a glass, and dissolved, is proved to be muriate of copper, by sulphurated hydrogen.

The artificial muriate, heated in a retort, so as only to lose its water of crystallisation, passes to a brown: the acid then contracts itself into a smaller portion of oxyd: if this be thrown into water, the acid again exercises its action on the brown oxyd, and re-establishes it by degrees into green insoluble muriate.

If the distillation be advanced farther, there arises a partial disoxydation, and a formation of white muriate, which remains enclosed in an excess of black oxyd: if this powder be thrown into a glass of weak sulphuric acid, all the black oxyd is dissolved, and the white muriate remains.

During the distillation, very little oxygenated muriatic acid is exhaled, but pure oxygen gas, which is conformable to the theory. The brown oxyd cannot receive it, and so lets it pass freely.

As to the muriatic acid, it is seized on by the excess of oxyd; which is the contrary of what happens when in the distillation of the muriate, which is saturated with acid.

It results from the foregoing, that the white muriate differs from the green muriate, by having a less quantity of oxygen, and of marine acid.

M. Proust uses the same brown and black oxyd for the same substance: the brown passes to the black, when it is more condensed by heat.

On Alkaline Sulphurets.

By Professor Proust.—*Journ. de Phys.*

The intention of this paper was to determine with more exactness some facts relative to those substances, published by Berthollet, of which the principal were the following:—

"An alkaline solution does not attack sulphur in the cold way, without previously combining with sulphurated hydrogen.

"Sulphur cannot remain alone in combination in a liquid state with the alkalis; for if the sulphurated hydrogen is destroyed, which serves to support it in the aqueous solutions, the sulphur will be precipitated. The sulphurs, then, according to Berthollet, can exist only in a dry state; when they are dissolved sulphurated hydrogen is always formed."

If hydrate of potash and flour of sulphur be put into a flask, a few minutes after a re-action accompanied with heat, will cause a solution of the sulphur; and the product is an hydro-

genated sulphur of a beautiful red; the acids separate from it, sulphurated hydrogen.

M. Proust means, by the hydrate of potash, the combination of the latter with water: this, crystallised and distilled, yields 30 per cent. of water. By this operation, the potash is brought to its pure state, and it is then that it resumes the property of giving heat with water.

If flour of sulphur be thrown into liquid potash of 126 degrees, (water being 100), at the end of ten or twelve hours a solution takes place: if potash of 133 or 134 degrees be used, the solution is more rapid and abundant.

A mixture of four drachms of lime, two of carbonate of potash, the same quantity of sulphur, and four or five ounces of water, heated to ebullition, produces an alkaline sulphuret of a high colour, and much charged with sulphur.

The carbonate of potash, heated to fusion, in a retort, with an equal weight of sulphur, produces a hepar, soluble both in alcohol and water; all these hepars, analogous in so many other respects, nevertheless differ in the quantity of sulphurated hydrogen which they produce. Of those prepared in the cold, there are some which yield a little of it to acids, and others in such very small quantities, that, besides precipitation ensuing, without the least effervescence, the odour of it can with difficulty be perceived.

Of those which are prepared by fusion and by boiling, there are few which yield sulphurated hydrogen in any abundance, and many which do not produce more of it than the preceding kinds.

The sulphurets which do not yield this gas to acids, have a smell resembling that of the herb cochlearea or horse-radish; and M. Rouelle and M. Deyeux have found, in alcohol charged with the essential oil of those plants, crystallised sulphur.

Those sulphurets which produce gas with acids, do not however yield it if much diluted with water; because the gas, in quitting the potash, dissolves in the water, although it may be supersaturated with acid: this effect is analogous to that of carbonated alkali, which either gives out its acid gas, or does not, according as it is diluted with little or with much water.

These results demonstrate that the presence of sulphurated hydrogen is not essentially necessary to the solution of sulphur, as supposed by Berthollet, since some sulphurets yield it either in very minute portions, or not at all.

Facts of another kind prove still farther the very small quantity of this gas contained in some alkaline sulphurets.

Fluid mercury has no action on fresh alkaline hydrosulphuret: but if this be coloured by the admission of air, or by the reduction of a part to pure sulphur, the mercury will whiten it by taking up the sulphur, and reduces it to pure hydrosulphuret of potash; but leaves united to it a small portion of ethiops; which last is separated by mixture with water, and the liquor

is then a pure hydrosulphuret; acids disengage from it gas in abundance.

But if this metal be mixed with a sulphuret from which the acids separate no gas, it reduces it to a potash in which there is found a small quantity of hydrosulphuret, and consequently of ethiops; but the quantity is so small that in precipitating the sulphur, no effervescence is produced, and the odour alone of hydrogen is perceptible.

On the other hand, red oxyd of mercury takes up the hydrosulphuret from liquid sulphurets without touching the sulphur. This method always shewed the presence of some hydrosulphuret; in all such combinations, but in many in very small portions.

The fact was also proved by a method suggested, from what Berthollet had published, which discovers the smallest quantity of sulphurated hydrogen which is contained in sulphurets, more expeditiously than by agitating them with mercury.

It is as follows: An ounce phial is to be filled to a third of its capacity, with marine acid of ten degrees; the same quantity of sulphur is added: at first there is no disengagement of gas; but as soon as all the sulphur is put in, and the phial stopped and shaken, the compression of the parts occasions the mixture; the hydrogenated sulphur separates itself, and there only remains to separate the liquors, and wash it in several waters, to have it pure.

Besides sulphuret of potash, those of barytes and ammonia were also tried by the above method, and the action of various acids was also proved, from all which the following results may be drawn.

1st. That liquid sulphurets of all kinds contain sulphurated hydrogen in proportions singularly varied; but as there are found among them continually, those kinds which have scarcely any of it, it is to be presumed that its presence is not indispensably necessary to their solution.

2d. In treating a liquid sulphur with mercury. The sulphur is taken up, and the sulphurated hydrogen contained is discovered, but mixed with ethiops, at least when this last has not had time to pass to the colour of cinaber.

3d. Red oxyd of mercury decomposes the sulphurated hydrogen; its sulphur unites to the remaining sulphur; the reduced mercury retains a part, and the liquor contains only simple sulphur. Nevertheless, as its analysis by the mercury always shews some atoms of sulphurated hydrogen, in perfect strictness it is true that there is not any liquid sulphur without sulphurated hydrogen.

4th. Liquid sulphuret of barytes follows, with regard to this gas, the same variations as that of potash, and, analysed by mercury and its oxyd, gives analogous results.

5th. Super-oxygenated muriate of potash does not alter the simple sulphurets, or hydrosulphurets, not even the hydrosulphurets of potash or of ammonia.

But it is still unknown wherefore it happens that the sulphurets do not contain sulphurated hydrogen, in proportion to the sulphur which they possess, and what are the causes that favour or restrain the production of this gas.

The Argil of Halle, in Saxony.—Ann. de Chim.

ACCORDING to the analysis of M. Simon of Berlin, 100 parts of this earth consist of,

Pure Argil - -	32,50
Sulphuric acid - -	19,35
Oxyd of Iron - -	0,45
Lime - - -	0,85
Silex - - -	0,45
Water - - -	47,

This analysis was compared with that made by M. Fourcroy, published in the Annals of the Museum of Natural History; according to which, 100 parts contained,

Pure Argil - - -	45
Sulphate of Lime - -	24
Water - - - -	27
Lime, Silex, and Muriate (of Lime)	4

It is concluded, because only some traces of sulphate of lime were found in this earth, that the kind analysed by M. Fourcroy was not true earth of Halle.

Observations:—This is a remarkably pure argil; the foreign matters mixed with it being in less than usual proportions, are also of that kind, that makes this earth peculiarly fit for some particular manufactures, which will be obvious to those who understand them. If a conjecture might be hazarded, contrary to an opinion delivered in a work of so much authority, it would seem probable that it might still be the earth of Halle that M. Fourcroy analysed; for as M. Simon found lime 0,85, and sulphuric acid 19,35, and water 47, all component parts of sulphate of lime; and as it is well known how much stronger the attraction is of sulphuric acid to lime than to argil; it does not seem very likely that this acid should either be found united to the argil and not to the lime, in this earth, contrary to its usual affinity, or that it should be found in an uncombined state, in contact with a substance to which it has such a strong attraction as to lime.

Analysis of the Lard Stone, and other Steatites.

By M. VAUQUELIN.—*Journ. de Phys.*

THE most remarkable circumstances in this analysis are, that a stone of this species should be found which contained no magnesia, (which has hitherto been considered as a necessary component part of steatites, on which depended their unctuosity and smoothness), and that two specimens, both denominated lard-stone, and similar in fineness of grain, smoothness, fractures and specific gravity, and differing only in colour (one being a rose colour, and the other a yellowish white), should be so very different in their analysis: whence M. Vauquelin justly infers, that it should be an invariable rule never to class minerals from the external appearance alone.

The first of these substances examined was laminary talc, of a greenish white colour, very soft to the touch, dividing into very thin flexible laminæ of a silvery white. The second was glaphic talc, generally employed in sculpture, commonly called *lard-stone*, and by the Germans *bildstein*. It is compact, its fracture dull, rough, and at the same time scaly, very unctuous, of various colours, grey, yellowish, greenish, and reddish.

The two specimens of this kind were one of a rose colour, and the other a yellowish white, which was obtained from a broken Chinese idol.

Analysis of Talcs.

Greenish flexible Laminary Talc.		Compact rose-coloured Glaphic.		Compact yellowish Glaphic.	
Silex	62		64		56
Magnesia	27		22		
Alumine	1,5		3		29
Oxyd of Iron	3,5	with Manganese	5	Iron	1
Water	6		6		5
				Lime	2
				Potash	7
	100		100		100

By boiling 100 parts of the last species, in concentrated sulphuric acid for two hours, M. Vauquelin obtained 36 parts alum, in cubic crystals; on farther evaporating the mother water, 15 more; and on pulverising the same matter anew, and treating it as the first time, 15 more; which in all is 66 parts of alum produced without the addition of any alkali.

Note.—M. Vauquelin does not state the quantity of sulphuric acid he used. A slight error has somehow, in the original, entered into the statement either of the sum of alum produced, or that of the component parts, as the whole amount of alum put down is only 60 parts.

M. Vauquelin observes, that the third species analysed should no longer be ranked among the Talcs, but should be classed with the *alkaliniferous* stones.

Solution of Sulphur in Ether. By M. FAVRE.—*Journ. de Chim.*

M. FAVRE put ½ ounce of flowers of sulphur into each of two six-ounce matrasses, and one ounce of rectified sulphuric ether; one matrass was placed in the dark, the other in a very light situation, and both shaken well every day for a month.

It was found, on analysis, that the ether exposed to the light took up most sulphur, amounting to 38 grains, while that in the dark dissolved but 29 grains.

He also tried muriatic ether for the same purpose, which took up but 13 grains of sulphur to the ounce; acetic ether, which dissolved but 3 grains; nitric ether, which took up 22 grains; and alcohol of 43 degrees, which took up 23 grains to an ounce, on being digested twelve hours over a slow fire. The sulphuric ether appears therefore to be the best menstruum for sulphur.

M. Favre observes, that as a method of administering sulphur medicinally, in a state of great division, has long been sought, for diseases of the breast and skin, which does not give the detestable taste to substances mixed with it, which the solutions in essential oils do; that this solution in ether will be very serviceable, as it has neither bad taste or odour, and easily mixes with draughts. It also forms an excellent test for detecting the presence of lead in wines, as it precipitates it readily without injuring the wine, which sometimes happens when the sulphuret of potash is used for this purpose.

M. Favre mentions, that he has used it with success as a medicine, and that several physician among his acquaintance employ it with advantage.

New Method of reducing Precipitate of Platina to a malleable mass. By Mr. ALEXANDER TILLOCH.—*Phil. Mag.*

Mr. TILLOCH recounts the various methods hitherto used for this purpose as follows.

1st, Dissolve crude platina in nitro-muriatic acid; precipitate by muriate of ammonia, wash and dry the precipitate; mix it with arsenic; expose it to such a degree of heat as shall volatilize the latter, leaving the platina in a spungy form; which by gentle hammering, and repeated exposures to high degrees of heat, is rendered solid and malleable.

2. Mix the precipitate with twice its weight of mercury; bring the whole to an amalgam; which is then moulded into the form of bars; by exposure to heat, freed from the mercury; and then hammered into a solid form by degrees.

3. Expose the precipitate in a crucible to such a degree of heat, as may agglutinate the particles, which by pressure are brought to a closer union while in the crucible, and afterwards hammered.

Mr. Tilloch's method, differing from these, consists of enclosing the precipitate of platina (prepared as in No. 1), in a hollow cylindrical case of malleable platina, closing its ends, exposing it to a sufficient heat, and hammering between each exposure, till the whole is brought to a compact state.

The precipitate should be tightly rammed into the case, which latter may be formed by a plate of platina rolled out in a flatting-mill, and bent round into the shape required.

The mass should be hammered first, where the case overlaps.

White Lead.—L'Esprit des Journ.

M. Doberimer proposes the following method to make white lead. Dissolve litharge in weak nitric acid, and precipitate this solution with prepared chalk. The precipitate washed and dried, affords a ceruse of the whiteness of snow.

Observations.—The work whence this article is taken, declares this method to be more quick, economical, and certain, than that in common use. As to the certainty of this process, there is reason to doubt it so much, that it should not be inserted here, if it were not so very easily tried, that if it does not succeed, it can cause no great trouble, and that even in this case perhaps the experiment might suggest some means of effecting the same purpose on similar principles.

Account of an Apparatus for purifying infected Air (which acts for some months with a single charge).

By M. Guyton de Morveau.—*Ann. de Chim.*

This apparatus is formed of a vessel of very thick glass, which holds about three half-pints: the edge of the vessel, which is very thick, has a strong glass plate ground on it so as to fit it perfectly close. This vessel is fixed in a small frame, resembling a press, which has a screw in its upper part, that serves to elevate or depress the plate of glass, so as to open or shut the apparatus at pleasure.

To produce the disinfecting gas, the vessel is taken from the press, and one ounce three drachms of black oxyd of manganese, in powder, after being sifted, put into it, together with a decilitre (the fifth of a pint) of pure nitric acid, of the specific gravity of 39 degrees of Baume's areometer, and the same quantity of marine acid, of 17½ degrees: the vessel is then replaced in the press, and the glass-plate screwed down tight, after carefully wiping all dirt from the edge of the vessel: two thirds of the vessel must be left empty for the gas.

When it is required to purify the air of any place; it is only necessary to turn the screw the reverse way a single round, and leave the vessel open a minute or two according to the size of the place, till the odour of the gas is perceptible in every part of it; after which the whole should be closed tight again.

This apparatus, with a single charge of the above materials, may be used every day for six months, without renewal; and when its effect ceases, the vessel is to be emptied, rinced clean, and filled again as before directed.

In opening the vessel, care should be taken to keep it in an upright posture, to prevent spilling the materials enclosed; and to hold one's head a little from it, to avoid breathing the gas, which, though not dangerous, is a little disagreeable.

This apparatus is very useful to purify the air in hospitals, prisons, sleeping-rooms, and work-shops, and, in fine, in every place where the air becomes vitiated, either from crowded meetings, or other causes. It is now in use in the different hospitals of Paris, in those of the departments, and of the marine.

This apparatus is made for sale, by M. Dumotiez, instrument-maker, Paris. He also prepares a smaller portative sort, contrived likewise by M. Morveau, which consists of a strong bottle (closed, as described in the former, by a strong plate of glass and a screw), the whole is enclosed in a case of box wood, which serves to keep the plate of glass in its place. The charge for this is four grammes (about one drachm) of manganese, and about a centilitre (the 50th part of a pint) of nitric acid, and the same quantity of marine acid: from these proportions, it seems the bottle should hold about half a pint. When the mixture becomes a little old, it should be shaken in the bottle, before unscrewing the stopper.

M. Dumotiez prepares bottles of a still smaller size, in the same manner, which he sells for three francs.

The top of the case should have an opening to let the gas pass, besides being contrived to take off occasionally.

Observations.—This is a very convenient apparatus, worthy the attention of all medical gentlemen. Besides the situations where it is of use, mentioned above, it would also be extremely serviceable in ships, and is so very handy, and may be afforded so cheap, that it is probable no captain would go on any distant voyage without one, if its utility were explained to him,

in preventing infections of all sorts, not excepting that of the yellow fever.

If the glass plate should be broken at sea, or elsewhere, where it cannot be easily renewed, a piece of caoutchouc, fastened under a cover of wood, would make a good substitute for it; and it might be advisable to have a cover so prepared with every apparatus to use in case of accidents.

The screw, and every other part of the apparatus, should be of wood; as any thing of metal near it would be easily corroded by the gas.

Conceiving these fumigating bottles to be of great public utility; and that of course it would be very serviceable to have them as easily procured in this city as in Paris; means have been taken to induce Mr. Lloyd, No. 178, Strand, to have them made for public use, fully equal to those described in every respect.

Method of preparing Gallic Acid pure.

By Mr. Richter.—*Ann. de Chim.*

A pound and a half of gall nuts, reduced to a fine powder, are to be digested in cold water, taking care to frequently stir the mixture. At the end of some time this is to be strained through a linen cloth; the residue is once more to be mixed with water, and submitted to the press; the two liquors thus procured are then to be evaporated in a gentle heat: a matter of a brownish black, and very brittle, is thus obtained. This matter, pounded fine, and digested with very pure alcohol, gives it a pale yellow colour. A second infusion is almost colourless, and leaves a brown residue, which is almost entirely pure tannin. The two infusions in alcohol are to be mixed and distilled in a small retort, "by refrigeration," to an eighth part. The liquor appears now extremely thick; water poured on it, and a gentle heat applied, will give an almost clear solution, very little coloured.

This aqueous solution, properly evaporated, will give prismatic crystals, very small and very white.

The mother water may be made to produce more crystals, but they are commonly a little coloured; it is only necessary to wash them in water to obtain them very white: a pound of gall nuts will thus produce half an ounce of crystals, which are very light, and consequently bulky.

1st. These crystals are less soluble in water than in alcohol, the aqueous solution reddens the tincture of turnsol: they combine with alkaline carbonates, and disengage from them the carbonic acid.

2d. The solutions of iron are precipitated black by the alkaline gallates; all the other metallic solutions are decomposed by these combinations. If a very clear solution of iron be added to a solution of very pure gallic acid, the mixture does not become coloured till the solution of iron is decomposed by the external air. This last fact may be used as a test of the purity of the gallic acid.

From the above, it follows, that all contact of iron should be avoided in the preparation of this acid, even in the filtering paper, which is rarely free from it; and that alcohol may serve to separate the gallic acid from the tannin, since the first is very soluble in it, and the latter scarcely at all: but, for this purpose, the alcohol must be very strong and pure; for if it contains any water, tannin will be dissolved.

Many reasons are added to shew the superiority of this method to those hitherto used for the same purpose, as to certainty, cheapness, facility, and the purity of the acid produced.

Of the Proportion of Gold and Tin in the mixed Precipitate of these Metals, and the Colour produced by it in filters.

By Mr. RICHTER.—*Ann. de Chim.*

THREE ounces and a half of tin were dissolved in muriatic acid, so as to completely neutralize the acid, and one ounce of gold was also dissolved in like manner in muriatic acid. The gold employed had been precipitated by sulphate of iron, and the precipitate washed with muriatic acid.

The solutions were diluted with about twenty parts of water, then divided into several portions, afterwards they were mixed together and well stirred, at the end of six hours the mixture became clear, and the precipitates sufficiently formed to admit of the liquor being decanted clear from it.

All was then united in the same vessel, and after a few hours more of the liquor was decanted off. The liquor, separated from the precipitate, gave, with carbonate of soda, a little white oxyd of tin.

The purple precipitate was washed ten times, in ten times its quantity of water, then it was collected on filters weighed beforehand; dried in a gentle heat, its weight was 1970 grains: it consisted of small pieces of a deep violet colour, of which the surface seemed to have somewhat of the brightness of metallic gold.

A hundredth part of the precipitate well ground, and heated to a cherry-red heat, in a crucible, lost five parts of its weight: in supposing, then, that these five parts were water, the 1970 parts contained 98½ of water, and there remained 187½ for the oxyd

of gold and of tin; but as 100 parts of metallic gold acquire almost 25½ of oxygen, the quantity of gold employed ought to absorb 122 parts, and form 602 parts of the oxyd of gold; in deducting this quantity from 1871½, there remains 1269 for the oxyd of tin, which contains then exactly the quantity of oxygen necessary for its solution in the acids, that is to say, almost 19½ parts per cent. which reduces the quantity of metallic tin to almost 1019 parts.

Powder of metallic gold, triturated with white fusible glass, laid on a cup of white porcelain, and exposed to a degree of heat sufficient to melt the glass, without fusing the gold, will exhibit a tint of purple, under the place where it adhered to the porcelain, on being forcibly separated from it; but if the heat be increased, so as to fuse the gold, this purple stain does not appear.

From this it is concluded, that the opinion of the necessity of metals being in a state of oxyd, to admit of their vitrification with other bodies, does not hold good with respect to gold; and that, in consequence of a certain degree of heat, solutions of metallic gold may exist in many bodies not metallic, under many unknown forms: those in the alkaline sulphurets might be here instanced.

Eight parts of vitrifiable flux added to one of the purple precipitate of gold and tin, here described, produces a most beautiful purple colour, surpassing all produced in the other experiments, except that caused by the reversed proportions of the same ingredients, whose colour differed only in being much deeper.

The same results will be produced, if vitrified borax be used instead of the fusible flux.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

On the Substances used for the Clarification of Wines and Beer, and Means of increasing the Supply of Fish Glue.

By M. PARMENTIER.—*Ann. de Chim.*

M. PARMENTIER thinks that the whites of eggs afford the best substitute for clarification, and that the action of fish glue, for the same use, is chiefly caused by the albumen contained in it. On account, however, of the great difficulty of procuring any number of eggs, without some musty, or otherwise ill tasted, being among them, and the unconquerable bad flavour which this gives to wine, he much recommends the general use of fish glue for this purpose in preference.

He mentions that the air-bladders, intestines and skin of various other fish besides the sturgeon, will produce good fish glue.

The Laplanders procure it from the perch fish; and, in general, all the genus of fish known by naturalists by the appellation of cartilaginous, such as rays, sea-dogs, &c. produce a glue very tenacious in great abundance.

All fish, likewise, which are little covered with scales, which live in still fresh water, or in bays little agitated by wind, or which lie in the mud, are very proper to furnish, from all their parts, a gelatine, more or less pure, according to the care taken in its manufacture.

The air-bladders of the cod-fish also produce good glue. In the north of Europe they make a great deal in this manner: they cut out the vesicles with their ligaments, cut them in two, and remove the first skin with a notched knife, then lay them in lime-water, and afterwards wash them in pure water, and dry them. This was attempted at Newfoundland, but was laid aside because they could not spare hands from the fishery; wherefore, they now salt the vesicles for food, and they are considered as very wholesome and nutritive. Many other fishes of this species, as well as the cod, furnish materials for glue.

The cuttle-fish, the sea-blubbers, and similar boneless fish, with most animals of the mollusca genus, furnish the very best gelatine that can be procured, if care be taken to prepare it in a proper manner. It is of similar substances that a species of

swallow forms those nests which are in such high estimation in China, to form restorative soups.

M. Parmentier thinks, that on account of the less specific gravity of fish glue, it is not so nourishing as the gelatine extracted from land animals; and also that it is not so tenacious as glue formed from the skin and bones of quadrupeds; both of which notions are contrary to general opinion.

M. Parmentier mentions, that in some breweries abroad, they boil down all the calves and cows feet they can procure, to form gelatinous matter to clarify their beer; and that when these were scarce, they have been known to boil down an entire calf in their coppers, after removing the fat; and that cartilaginous fish are also used for the same purpose, when the situation is favourable to procure them. Serum of blood has likewise been used by them, but that they would seldom confess this, knowing the repugnance most have for such matters.

M. Parmentier examined the finings (or clarifying mixture) used by several brewers, by chemical tests; from which it appeared that their basis was an animal gelatine, precisely of the nature of Flanders glue, and had not the least resemblance to fish glue.

Of the other matters which have been used to fine liquors, M. Parmentier mentions milk and blood. He thinks milk is bad, on account of the great quantity of serum that would be left in the liquor; but that sheep's blood, used quite fresh, has probably a good effect. He does not recommend its use, on account of the difficulty of procuring it in this state, as nothing corrupts so soon.

He also mentions that very fine sand, well washed, mixed with the liquor, is a good clarifyer, and has the advantage of cheapness.

Charcoal dust, well washed, will also fine liquors very well.

He recounts another matter, not so advisable for liquor, which is metal in grains, particularly lead, but which is the best for clarifying oils and rendering them colourless. It is not merely by its weight that lead acts on oil, but by a chemical process; for small shot, put into a vessel of oil, soon becomes oxydated at its surface, and this oxyd attracts the colouring matter of the liquor, which he supposes somehow assists the union of the mucus to the oil; for, in proportion as the colouring matter is attracted by the oxyd, the mucus separates from the oil, and falls to the bottom, by which the oil becomes more fluid, almost colourless, does not congeal in cold weather, burns with brilliancy, and yields little smoke.

M. Parmentier, in conjunction with M. Pelletier, also proved, that in many cases the clear jelly, procured by boiling raspings of bone in a small quantity of water, might be advantageously substituted for fish glue.

Observations.—M. Parmentier passes over the effect of charcoal dust, as a clarifyer, more hastily than it seems to deserve: from

its known attraction to mucilaginous matter, it promises to have great effect in clearing liquor, and perhaps might be used to advantage, after gelatinous finings, to separate them more completely from the liquor.

As a clarifyer, in the same class as fine sand, very pure pipe-clay deserves notice. It separates, on rest, entirely from the liquor with which it is mixed, and draws down with it more extraneous matter than sand can; which qualities makes it worthy of sufficient trial.

The recommendation of M. Parmentier to his countrymen, to procure fish glue from the animals found on their own coasts, may with great propriety be extended to this country. Animals of soft substance (the more proper for this manufacture as they are never used for food), are to be found on our coasts in many places in abundance. Hundreds of the fish, often called sea blubber, are frequently seen at no great distance from the coast of Milford; and no doubt they, and others of the same kind, and of the sorts before mentioned, as proper for making fish glue, might be procured in many places in sufficient quantity to pay well for the trouble of boiling them down into glue.

Of the Pyrosoma Atlanticum. By M. PERON.—*Journ. de Phys.*

M. PERON, on his voyage from Europe to the Isle of France, observed this animal, between 3 and 4 degrees north latitude, and 19 and 26 degrees west longitude, from the meridian of Paris. Its phosphorescent quality, so truly prodigious, renders it one of the most beautiful of zoophites known, and its organisation ranks it among the most singular.

When it was first discovered, the vessel which carried M. Peron and his associates had been becalmed for a considerable time, and could not advance southward but by the aid of little transient breezes, peculiar to those climates, which their sailors called tropical gusts: at last they experienced one of the most violent of these. In the evening the sky was on all sides obscured with thick clouds—the darkness was intense. The wind blew with violence, and the progress of the vessel was rapid. All at once there appeared, at some distance, as it were a vast sheet of phosphorus, floating on the waves: it occupied a great space before the vessel. This spectacle, in the midst of the circumstances before described, had something grand and majestic, which attracted the attention of every one: all on board came immediately on deck to view this singular phenomenon. The vessel soon passed through this inflamed part of the sea; and they discovered that this prodigious light was occasioned entirely by an immense number of large animals, which, borne on the waves,

and drawn along by them, swam at different depths, and appeared to assume various forms. Those which were deepest looked like great red-hot cannon balls, whilst those on the surface resembled perfectly great cylinders of red-hot iron.

Some of them were soon caught, and were found to be as follows:—they all resembled each other as to form, colour, substance, and phosphorescent quality, and differed only in their size, which varied from three to seven inches.

This animal was of a long form, almost cylindrical. Its anterior extremity was thickest, and was there, as it were, cut perpendicularly across. A large circular opening in this part easily permitted the internal of the animal to be seen, which was tubular and empty, without shewing any other trace of organisation, but a very fine vascular reticulation, which lined all the inside of this cavity.

A ring of thick tubercles occupied the border of this opening internally, and diminished by this means by almost one half the diameter of this otherwise extremely large species of mouth.

The posterior extremity was less thick, ended obtuse, and exhibited not the least trace of any aperture.

All the exterior surface of the animal was bristled with thick oblong tubercles, of a more firm substance than the rest of its body, more transparent likewise, brilliant, and shining like so many diamonds: and these seemed to be the principal seat of its wonderful phosphorescence. Between those thick tubercles others appeared, shorter, more obtuse, closer together, and phosphorescent in the same manner.

In the inside also there appeared a multitude of little oblong narrow glands, which equally possessed the phosphoric virtue in a high degree.

The colour of these animals, when in repose or dead, is of an opal yellow mixed with a disagreeable green: but, on the slightest movement of those spontaneous contractions which it exercises, or those which the observer can at pleasure cause by the least irritation, the animal inflames, and becomes instantly like red-hot iron, and of a most brilliant brightness: and as this metal in cooling exhibits a variety of colours, so the animal, in like manner, as it loses its phosphorescence, passes through a number of tints successively, extremely agreeable, light, and varied, such as red, aurora, orange, green, and azure blue: this last shade is particularly lively and pure; and it is in this colour its figure ought to be painted, in the opinion of M. Lesueur.

These animals, left at rest in a vessel of water, perform alternate contractions and dilations at regular intervals, analagous to those of the respiration of the more perfect animals. At each of these movements the phosphorescence increases in the contraction, and diminishes in the dilation, insensibly, till it disappears, to return again speedily on the next contraction.

Its power of locomotion seems very small, and seems to consist entirely in a retrograde movement caused by the re-action of the water driven forth on the contraction of its cavity; at least this was the only mode of motion that was observed.

M. Peron thinks this animal may be nourished by absorbing molluscas along with the water into its inside, and retaining them there by the contraction of the ring of tubercles which forms its mouth.

As to their mode of re-production, he could say nothing positive from observation; but thinks it very probable, that they are produced, like many of the polypi species, by germination: that the long tubercles, described growing on their outside, detach themselves, and become perfect animals when arrived at a certain size; and that the smaller and shorter ones, observed in the intervals between these, were destined to supply their places as they dropped off, and afterwards become in their turns distinct animals likewise; and as this mode of production appears analogous to the simplicity of organisation observed in this animal in other respects, and tends to account for their prodigious numbers, which necessarily proves a rapid multiplication, there is the more reason to suppose it to be that which really takes place.

M. Peron could not observe any different species of this animal: they appeared to hold their residence between 19 and 20 degrees west longitude from Paris, and between 3 and 4 degrees north latitude; the temperature of the water in which they were seen, was at 22 degrees of Reaumur's thermometer.

This last is noticed, because M. Peron has found that every species of polypi and mollusca are not disseminated by chance over the surface of the ocean, but that each is confined to certain latitudes and longitudes, where the temperature, probably more than any other circumstance, forces them to remain.

Observations.—There is an apparent contradiction, in the accounts given of the size of this animal on its first appearance, and in the more minute description.

This is easily reconciled by the well-known property which phosphorescent bodies have of appearing at a little distance in the dark to be of much greater bulk than their actual size.

Method of converting a circuitous Motion into an alternating rectilinear Movement.—Ann. des Arts, &c.

The most common method of effecting the conversion of motion, mentioned in the title, is by a crank operating on a rod, which has the same effect as attaching the extremity of the rod to a pin on some part of the radius of a wheel, in such manner as

not to encounter with the axis: which method is defective, on account of the power and velocity differing from the greatest to the least, twice in every revolution of the wheel.

Mr. Morland, in 1685, contrived another method for this purpose; he used an ellipse, turning on one of its foci, on whose edge a moveable point pressed; which received an alternating motion from the circumference of the ellipse pressing it in its revolution to different distances from the centre of motion. This movement is known in England by the name of the Heart-wheel, and is common in cotton-mills.

M. La Hire's method was the next contrived, which consisted of waved excavations on the circumference of a wheel, which put pump-pistons in motion. The waved surfaces, it is evident, might be either used in a vertical, or in a horizontal wheel; but in the latter case, the edge of the wheel must project considerably at right angles, beyond its plane.

Wheels toothed only at regular intervals, working on pinions, have also been employed for this purpose, in many of the various ways in which this principle has been applied; several of which will be found detailed in the collection of machines, published by Ramelli, in 1620, in Germany.

Mr. White, an Anglo-American, contrived the following method for the same purpose: A fixed circular ring had teeth at the internal of its circumference all round; a smaller wheel, only half the diameter of the ring, toothed at its edge, moved within the ring; a moveable piece, connected its centre with that of the ring; the teeth of both were of course in contact; when the moveable piece was turned round, the small wheel made two revolutions, for each one of this piece. The instruments which were to receive the alternating movement, were attached to any part of the circumference of the small wheel, and of course made as many changes of position as the small wheel made revolutions.

Observations.—Mr. White's method is not the best of the above: though the Editor of the *Annales des Arts* has mentioned it in terms of praise, it will be found, on examination, to be little superior to the common crank. If the instrument which is to receive the alternating motion be attached to the centre of the small wheel, the effect will be exactly the same as that of the crank; and if fixed, as directed above, the rod will receive a double motion in each revolution of the wheel, which would produce very unequal effects, for it would, in that period, once move back and forwards through a space equal to the diameter of the large ring, and twice through a space equal to that of the diameter of the small wheel, and each change of direction be subject to all the inequality of motion of the common crank.

A contrivance for the converse purpose of this, may be seen in the steam-engine of Messrs. Cox, Curtis, and Co. in which the alternating rod gives movement to the fly wheel, by means

of a fixed ring, with inside teeth, within which a smaller wheel revolves, to whose axis the extremity of the rod is attached: but the power of this is not superior to that of the common crank for the same purpose.

There have been many other contrivances for the same purpose, besides those enumerated, of which one shall be described here: It consisted of a circular plane, placed horizontally on a centre, so as to admit of nutation only, but not of circuitous motion; to various parts of its circumference two or more pump-rods (or other matters, requiring to receive a similar motion) were attached: the plane received its nutating motion from an arm projecting upwards (from a perpendicular arbor turned round by a horse, or other power) above the level of the centre of the plane: the top of this arm carried a small friction wheel, which, as it went round, raised every rod in turn to its own elevation, and depressed the opposite one proportionally by the height to which it caused one side of the nutating plane to rise and the other to descend.

Of these methods, that of M. La Hires is the best, in which a wheel carried a projecting waved edge at right angles to its planes; for by its means the alternating rod received a motion, not only of equal power in all its parts, but of equal velocity also.

The next best to this is the last described; that of Mr. Morland, is only superior to the crank in affording greater variety and modification in its application: and Mr. White's, to all the defects of the crank, adds that of unnecessary complication.

In the *Annales des Arts* the account of the different methods recited previous to Mr. White's, were mentioned in the beginning of the following paper of Mr. Prony's; but, being more analogous to Mr. White's invention, it was thought better to class them with it.

Method of causing alternating rectilinear Motion of any proposed duration from a circular Movement.

By M. PRONY.—*Mem. Inst. Nat.*

THIS species of motion, though it has sometimes been classed with the foregoing, yet differs so materially from it in its effects and application, that it deserves a place to itself. The first is used principally in pumping, stamping, and such motions as require speedy repetition: this last is used for drawing buckets from mines or wells, and requires no change of direction often for some minutes.

M. Prony had two methods for this purpose; in the first, an horizontal wheel, toothed at its face, lay just above two ver-

tical pinions, fixed on the opposite extremities of an axis of the length of its diameter. This wheel was so contrived as to incline a little from its horizontal position to either side at pleasure; so that on the one inclination its teeth locked with those of one pinion, and receded from the other; and on the other position, its operation on the pinions was reversed: by which the axis of the pinions turned round first in one direction, and afterwards in the contrary.

M. Prony, finding this method subject to some inconveniencies, contrived the following, which he esteems much superior to it.

An horizontal wheel, toothed at its face, and attached to a perpendicular arbor, (which gives it motion) turns two pinions, moveable on the same axis, which it meets at the opposite sides of its circumference: these pinions are not attached to the axis, but turn round freely upon it: the intermediate part of the axis is square, and has, adjoining to each pinion, boxes which slide back and forwards on it, each of which support a faced wheel, with strong serrated teeth; which serration is in a different direction on the opposite wheels: the boxes are connected by two iron bars, so as to change their places by one movement; to the pinions there are also serrated faced wheels attached, so as to lock on those opposite to them on the sliding boxes. From this construction, when the boxes are slided to one extremity of the axis, the pinion at that side will be connected with the axle, and communicate its motion to it in one direction; and when the boxes are moved to the other extremity, then the first pinion will be disengaged, and the second be locked to the axle, and cause it to turn round in a direction the reverse of that in which it moved before.

There is a lever on another axle, whose office is to move the before-mentioned boxes back and forwards: an arm projects from the axis, which moves between two pieces, proceeding from the frame connected with the boxes: the lever rises upwards, and has a weight at its top, by which it presses strongly in either direction, when it passes the perpendicular position; forming thus the contrivance vulgarly called a tumbling-bob, which is used in various engines for a similar purpose.

On the same axle on which the pinions move is fastened a drum-wheel, round which passes the chain or cord to which the buckets are attached; another chain or cord is placed below the buckets, from the bottom of one to that of the other, to form an equilibrium between the whole of the appendage of one bucket and that of the other in all positions.

A bar is so placed, that, on one of the buckets rising to a certain height, it catches the bar, forces it upwards, and thereby throws over the tumbling-bob connected with its other extremity: this reverses the movement of the buckets; and, on the other bucket rising, it operates in the same way on another lever,

which throws the bob to the contrary side, which causes the first bucket to rise again.

M. Prony has annexed to this engine a contrivance, by which the horse, which puts it in motion, is disengaged when any accident happens, that would tend to stop the movement of the wheels: for this purpose, the traces pass under two pullies in the ends of the yoke; and their extremities, which have loops wrought in them, are thereby attached to two pins in a roller, round which roller a cord is wound two or three turns, and passes from thence through rings in the lever; which causes the arbor to turn round, and over a pulley on the arbor to a weight which hangs beside it. When the draught exceeds this weight, it is evident the roller will be drawn round by the traces, and that they will slip off the pins, and be disengaged in the first turn.

Observations.—The principal use of this invention is for engines of this kind which are moved by horses; for, though it is equally applicable to those moved by steam, the attendants are become so very expert in reversing the movements of the latter, that it would hardly be worth while to add any contrivance to them for this purpose. A boy, twelve years old, performs this manœuvre in a steam-engine near Bristol (which draws up coals from a pit), without ever making the smallest deviation from the proper alternation of the buckets.

The method now in use for reversing the movement of the buckets, in such engines of this kind as are moved by horses, is by turning round the horse, and making him retrace his steps the contrary way. This is very injurious to the horse, for it not only fatigues him much to turn about in the very small space allotted him for this purpose, but these short turns tend greatly to strain his shoulders. On this account, the Society of Arts, a few years ago, offered a premium for communicating a contrivance for raising buckets from pits by horses, so as to reverse the movement of the buckets without obliging the horses to turn round the contrary way from their first direction. At this time, a model of a contrivance for this purpose was sent in by Mr. J. W. Boswell, which lay for some time at the Adelphi for inspection: but he could not be a candidate for the premium, as he had no opportunity of having his invention executed on a large scale, and put in actual work, which was an indispensable condition annexed to the offer of the premium.

His contrivance was much more simple than this of M. Prony's; consisting, merely, of a face-wheel, with two pinions, and their axle; without the sliding-boxes, multiplied ratchet wheels, tumbling-bob, or many other parts belonging to M. Prony's. It shall be described hereafter more particularly, in a succeeding Number of this Work.

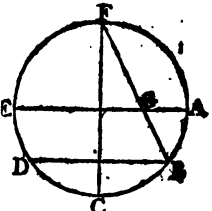
A practical Method of finding a Square nearly equal to the Area of a Circle.

By Mr. J. W. Boswell.—*Phil. Journ.*

On account of most calculations relative to gravities of fluids being computed for square measure, while the pipes and other containing parts in hydraulic and compound engines are circular, it is a desirable matter to have a ready practical method for converting circular measure into square measure.

Mr. Boswell found the following so nearly exact, that, on account of the utility he thought it would be of for common computations, he was induced to send it to Mr. Nicholson, for publication, if approved of by him.

Method.



In the given circle, draw two diameters (A E and C F), bisecting each other at right angles at the centre: Bisect one of the radii, so formed, in G, and, from the extremity (F) of the next adjoining radius, through G, draw the right line F B to the circumference; the square of this line F B will be very nearly equal to the area of the given circle.

The square, thus formed, was compared with two others; one constructed by the third Coroll. Prop. 5, of Archimedes, and the other equal to a parallelogram made equal to the given circle according to Kircher's method, mentioned in the *Ars Magna Lucis et Umbræ*, p. 239, and no perceivable difference in size could be discovered between them.

The circles used were discs of card, for the better measuring the circumference necessary in finding the areas. It is mentioned, that, as these were under three inches in diameter, a small error might escape observation.

Mr. Nicholson has calculated, trigonometrically, the proportion of the line (F B), found as above directed; and declares it to err only a hundredth part above the true side of the square found by computation.

As the method was only intended for practical purposes, such as measuring round timber, engine cylinders, pipes, &c. so small an error is not very material in general; and, even so, the method is more correct than that in common use: where more accuracy is required, it is easy to deduct a hundredth part from the line F B, and construct the square accordingly.

But, in most pipes and cylinders, it will be no detriment, but rather an advantage, that they should a little exceed the com-

putation for their size; so that, for them, it will be scarcely necessary to have a more accurate method.

Mr. Boswell, in a similar manner to that already mentioned, found the line DB, drawn from the extremity B of the line FB at right angles through the opposite diameter FC to the circumference, to be nearly equal to the fourth of the circumference.

A correspondent of Mr. Nicholson's has computed that this line DB errs by a seventieth part from equality to the fourth of the circumference; but, as the uses of this line are not so many nor so obvious as those of the other, this gentleman's computation is of no great importance.

Mr. John Gough has also published a calculation of these lines; and mentions, that this discovery "will undoubtedly prove useful to the artist and practical philosopher;" which induces him to undertake the investigation of the subject. The common expression for the area of the circle being ·7854, he computes the square formed on FB will be equal to ·8000; and, therefore, that it exceeds the area by ·0146.

Mr. Gough sees this matter in the right light; as it is evident, from Mr. Boswell's papers on the subject, that he never meant the method proposed for any but practical purposes, and for practical men.

As for those to whom a method of ascertaining the converse of the object of this paper may be useful, the following, also proposed by Mr. Boswell, is inserted, which is sufficiently near the truth for common use.

To construct a Circle nearly equal to a given Square.

To one side of the square add a ninth of its length, and use the whole as the diameter of the circle required.

Glue from various Materials examined.—Ann. des Arts, &c.

M. Cadet has examined the nature of glue, prepared from gelatine of beef, veal, mutton, fowl, fish, and from that of the horse; also, mixed glue, prepared from beef gelatine, the scrapings of hides, English glue, beef and veal mixed; and that from ox feet and sinews. The specific gravity of each was as follows in the table; and 5760 grains of each, exposed twenty-four hours in a cool cellar after being dried in a stove, absorbed moisture in the proportions therein set down; half an ounce of each glue, dissolved in water, was also satured with tannin, and the number of grains of precipitate were weighed, and found to be as noted in the table; in which, also, is marked the tenacity of each kind of glue, by the number of pounds and ounces which it took to detach two pieces of wood, of four square inches surface,

glued together with each kind of glue, and placed in a stove twenty-four hours before trial.

	Specific gravity.	Absorption.	Precipitate.	Tenacity.		Colour.
		grs.	grs.	lb.	oz.	
Glue of Veal	1352	198	71	110	6	Transparent, like horn.
—— Beef	1229	159	4	95	6	Very transparent, like barley-sugar.
—— Mutton	1344	171	50	107	6	Clear, dull redish.
—— Horse	1342	173	40	66	6	Almost opaque, of a deep redish brown.
—— Fish (of commerce)	1209	422	56	53	6	Like beef glue, but more transparent.
—— Fish (in cakes)	1231					
—— Fowl	1321	1298	36	99	6	Clear, of a dull bistre.
—— Beef & hide scrapings	1315	253	—	91	6	
—— Beef & veal	1350	160	—	79	6	
—— Ox heels & sinews	1351	124	—	—	—	
English glue	1347	144	60	121	14	

Each of the above columns formed a separate table in the original; but it was thought it would be more satisfactory to give the whole in one view, as here.

The precipitates were each of different colour and form: some were pulverulent, others filamentose, and others formed a magma.

As the tenacity depends, in some degree, on the wood subjected to the action of the glue, to the liquidity of the glue, its temperature, and the manner of application, the above comparison can only be considered as an approximation to an exact statement.

The solutions of English glue, of mutton, and of veal, had more viscosity than those of the others, particularly of the first in the following list, in which each is placed according to its degree of solubility in equal portions of boiling water:—

Beef glue	English glue
Beef and veal mixed	Beef and hide scrapings
Horse glue	Mutton
Ox heel and sinews	Veal

Of all the above, the English glue is the strongest; that of veal the next, and its gelatine the best for medicinal use. Beef glue is the least absorbent of moisture, and horse glue the weakest of all: mutton glue is the next to that of veal in its qualities.

Glue not only varies according to the animals whence it is prepared, but according to the different parts of the same animal: that made, for example, from the heels of beef, varies much from that made from its other parts, as may be seen in the table.

M. Cadet attributes the superiority of the English glue to the great care taken by the makers to put matters of the same nature in each boiling, and which are soluble in the same temperature, and furnish gelatine equally.

The goodness of the glue depends on the freshness of the materials, the choice of them, and their mixture; the washing of them, and the method of boiling, require, also, much attention; and, perhaps, the action of the lime on the first materials, may greatly influence the quality.

The construction of the furnaces is, also, very important in the manufacture of glue. Mr. C. visited several works, and saw none in which they were properly formed.

Observations.—M. Cadet very properly conjectures, that lime is an important article in the preparation of glue. In some small experiments made, of preparing glue from different substances, all that had not been limed, absorbed the moisture of the air so much, that they speedily became flexible: from this it is probable, that the liming adds to the strength of the glue; for it is evident, that any which absorbs moisture, must speedily lose its connecting power. There is reason to think, some glue-boilers use alum for the same purpose; as, in some account of the process lately published, with a different view than explaining the manufacture, it is directed to use a pound of alum for every hundred weight of the materials.

Sea-salt, even in small quantities, increases much the attraction of glue for damp: some materials, which cannot be got to harden permanently, it is suspected, owe this defect to the salt contained in them: indeed all animal substances contain some portions of it; perhaps the action of the alum may tend to decompose the sea-salt, and form in its place sulphate of soda, which is the most drying of all salts.

Glue is a very important manufacture, both on account of its extensive use in various arts, and the quantity exported.

The materials for it are becoming every day more scarce and dear; which makes it an object of consequence, to seek for others besides those in common use: in the paper on the Clarification of Liquors, some of those will be found mentioned, which might be applied to the general manufacture, as well as to the particular article of fish-glue. A great supply of excellent ma-

terials might be obtained from the whale-fishery, and that of the other different sea-animals which yield oil. A great part of the lower extremity of all those fish consists of sinews which would make good glue, together with their fins and tails. Mr. Raines, of Hull, obtained a patent in November, 1804, for making glue from the tail, fins, and gristly parts of the whale. There is, however, a part of the whale, not mentioned in Mr. Raines's specification, not of a gristly nature, which is very abundant, and which, from analogy, seems very likely to be a good article for this purpose.

Dr. Hunter, in his Anatomy of the Whale, mentions that the cutis and cuticle have in this animal very little connexion, which in all land animals form but one substance. The cuticle of the whale is very thin; and this, from its little adherence to the cutis, seamen esteem the only skin of the animal: but, under this lies the cutis, nearly an inch thick according to Dr. Hunter; and, it is this part that is here recommended. It is the cutis alone of the skin of other animals that is soluble, and very good glue may be made from this part of most animals. It is therefore so probable, that the same part of the whale might yield glue, that it at least deserves a trial: and as glue is now much dearer than fish-oil by the pound, those concerned in the whale-fishery might find their account in bringing home materials for glue as well as oil. The preservation of the parts of the whale fit for making glue might be effected by using lime for them, in the same manner as salt is used to preserve flesh for food; and it is very likely nothing more would be necessary but to cask them up with sufficient lime to fill every interval between each stratum, and absorb all moisture: when circumstances would permit, those articles should be dried as much as possible before being casked. The expense or trouble of taking out a few casks of lime for this purpose would be but trifling; and it is more than probable that whoever will make the trial once, will always bring out lime in future to prepare those articles.

The Dutch Method of Curing Herrings.—Trans. Soc. Arts.

THE busses employed in the fishery carry from 48 to 60 tons in general, though some are used from that size to 120 tons. The crews of the larger sort consist of 24 men, of the smaller 18.

The nets are cast in the evening, and drawn up in the morning, which last operation takes three hours. From the net the fish are put into baskets.

Twelve of the crew are employed in gutting, salting, and pack-

ing; which they can complete for but five last of herrings in a day, though sometimes fifteen last are taken in the same time: at this time the guts and gills are taken out, but the roe or milt is always left with the fish. What are taken during one night, are, before the following sun-set, neatly and skilfully packed in oaken casks, with Spanish or Portugueze bay-salt strewed between them.

The Dutch catch their fish regularly and early off Hittland, from the 26th of June to the 16th of July, because they are then fattest; after which, the nearer they approach the coast, the leaner and worse they are. During this time all the fresh-caught herrings are thrown into casks, without picking, and conveyed to Holland in the jagers or yachts that accompany the herring-busses; but, after this period, immediately on being got on board and gutted, they are sorted into three qualities, maiden herrings, full herrings, and shot herrings. The first are those taken earliest, which, though well-flavoured, do not keep: full herrings are those taken at Midsummer, on the point of spawning: the brand herrings (so called from the barrels which contain them being marked with a hot iron) are of the same kind as these latter, but so well packed on their arrival, and so close and hard pressed down, that they do not require re-packing at other places, but only new pickle; whereas the other sorts, not being so closely laid, must absolutely be re-packed: shot herrings are those which have spawned, and are consequently thin and lean. With the two last sorts the busses return to port as soon as they have got their loading, or find no more fish; here all, except the brand herrings, are opened, salted anew, re-packed, and so pressed that the contents of fourteen casks are re-packed in twelve, which makes a last. This re-packing, by law, must be performed in public, where strict watch is kept that the spoiled fish be carefully separated from the good, and the latter thoroughly pressed down and properly laid in the barrels.

The Dutch fishery continues from the 25th of June to the 25th of July on the Scotch and English coasts, off Hittland, Fairhill, and Bocken; and from thence to the 14th of September off Bocken or Senenial; and in the deep water off Yarmouth, and as far as the mouth of the Thames, till the 25th of November, when the regular fishery ceases: but herrings are found off Yarmouth till the end of January, after which the fishery is prohibited, as the spawning season then commences.

There are two methods of salting herrings, called white and red. In the former, the herrings, after being gutted and washed, are either put into baskets, and salt sprinkled in them, both inside and out, and well shaken in the baskets, or else are put in a strong pickle, which is preferable, for twelve or fifteen hours, and are well stirred several times, that the salt may penetrate; they are then taken from the pickle, drained, and

packed in barrels, which are strewed at bottom pretty thickly with salt; and if there be time, they are neatly laid in strata, always strewing salt sufficient upon each layer: when the fishery is very abundant, this last operation is deferred till landing, and in the mean time they are only thrown into the barrels promiscuously. On landing, they are re-packed and sorted, as before mentioned, and regularly coopered, to prevent leaking of the pickle, which spoils the fish. Properly, they should be packed after being one night in pickle: when this cannot be done, the fish do not keep so well, and are reckoned an inferior sort.

Fish that cannot be packed in two days after being caught, are salted in large heaps, and are called *slubbers*, or coarse goods: they are sent home in the schuyts, washed and smoked, though not so much as the *bicklings*, or red herrings. The salted herrings hitherto spoken of are called *pickled* herrings; those salted and packed in layers, *packed* or *barrelled* herrings; and those half salted and promiscuously packed, are called *wrack* herrings.

For red-salting, the fish must be at least twenty-four hours longer in pickle, are then taken out and hung by the head in rows on wooden poles, in stoves constructed for the purpose, each of which generally contains 12,000 herrings. In those stoves a fire is made under them with vine-stalks, or any green faggot wood that affords much smoke and little flame: but no deal or other resinous wood is suffered to be used. Here they remain generally twenty-four hours; and, when they are properly smoked, are packed in barrels, and called *barrelled bicklings* or red herrings; but if packed in straw, are called *straw bicklings*, which are somewhat less salted than the others.

In Holland, the best fish are chosen for smoking: but in other places the slabbers, or other inferior herrings, deemed unfit for the usual mode of salting, are only used.

The best red herrings are called, in German, *speckbuckling*: they are cut open along the back. The excellence of the red herrings consists in being large, fat, tender, fresh, properly salted, pliable, soft, of the colour of gold, and not torn or mangled.

On the Use of Amianthus in China.

By M. Le Sage.—*Journ. de Phys.*

The ancients, according to Pliny, made with amianthus an incombustible cloth. There is a sheet shewn in the Vatican, which is said to be made of this cloth. At present there is no use made of it in Europe: M. Le Sage has, however, some paper made of this substance about twenty years since by M. Levrier, of Lisle, of which he presented a sheet before the National Institute. It

has sufficient coherance, but is not so smooth as common paper; it does not sink under the pen, and can be written on with facility and neatness, if the ink be well gummed. This paper is not injured by the fire; it assumes in it, a tint of a clear grey, which is probably caused by the carbon of the glue with which it is prepared. The letters written on it appear of a red colour, after passing the fire.

M. Le Sage observes, if gum adracanth were used instead of glue to reduce the amianthus to a paste, the paper, then milled, would have a better consistence, and would be more fit to resist the fire. He regrets that M. Levrier, of Lisle, was not encouraged in his manufacture, as this paper of amianthus would have been of great utility for public deeds and registers, since it could resist the fire; from which it would be completely secure, if enclosed in cases or covers of amianthus.

The use made by the Chinese of amianthus is as follows: they know that it requires the most violent fire to vitrefy it, and that it is not at all altered in an ordinary fire; for this reason they make portable furnaces of it.

That seen by M. Le Sage was in the form of a hollow cylinder, nine inches high, and six inches in diameter; towards its middle, internally, a circular rim projected to sustain the grate. It had two apertures for the ashes. This furnace was supported by a sort of round dish with octagonal rims, which rested on four little cubes; these rims were ornamented with a running border that produced an agreeable effect, consisting of a succession of small circles, in the centre of each of which projected a little button.

The exterior and interior of this furnace had the polish of a smooth card, and its fracture resembled that of pasteboard: so that M. de Tersan, with whom M. Le Sage saw the remains of this furnace, said, "he could not conceive how the Chinese could make pasteboard contain fire." A fragment of this furnace was examined accurately, and proved to be entirely amianthus. M. Le Sage supposes the Chinese know the remarkable property which gum adracanth has, of giving a coherence to minute stoney substances, which are then unalterable by fire, and use it to form the paste with which they construct these furnaces.

This property of gum adracanth is best proved by the Bolognian phosphorus, made of it and pounded sulphate of barytes, which, formed into masses, neither alters their shape nor solidity from exposure to intense fire for several hours.

M. Le Sage supposes, that the Chinese make these furnaces in moulds, which gives the polish to the outside; the inside exhibits plainly enough the particles of amianthus of which it is composed. The colour of the furnace is a grey, inclining to a red: it grows white in the fire: in its substance it unites solidity with lightness.

M. Le Sage concludes with an account of a sort of stuff made in China, resembling French drugget, which is formed entirely of filaments of paper, and possesses both suppleness and solidity.

The Chinese have the art of making paper in pieces of eighteen feet in length, and of much stronger consistence than ours, which accounts for their being able to make this paper-cloth into webs of some length.

Observations.—Besides the uses pointed out by M. Le Sage for amianthus, it seems to be an excellent material for making crucibles for several purposes. The facility with which vessels could be made in the manner described above, and their requiring no baking, would make their use very convenient in laboratories.

On the Use of Coin made of Zinc, in China.

By M. Le Sage.—*Journ. de Phys.*

The zinc, known in China by the name of *toutenague*, is not merely used to form metallic alloys. They also form coin of it, of which M. de Tersan gave M. Le Sage a piece, which he assayed.

The coin is about the size of a franc, but not so thick: in the centre is a square perforation, three lines in diameter; on two portions of the face, at each side of this aperture are Tartarian characters; on the reverse there are Chinese characters on all its four divisions.

This piece broke short on attempting to cut it with sheers: its fracture exhibited the colour and the metallic facets of zinc. It had, in the same manner as zinc cast in small plates, a line, which separated in two each piece of metal. This line is caused by the heat which occupies the centre of cast zinc.

This fracture, shewed that in China, zinc is fused to form the coin: for when this metal is drawn out by rollers, and its grain compressed, it ceases to be brittle, and shews no more grain: zinc reduced into sheets by this means, ceases to crackle like tin when it is attempted to be broken. This demi-metal, far from hardening under the pressure of the rollers, becomes the more ductile as it is reduced into thinner laminæ.

The zinc of which this coin is made is very pure, and burns with a brilliant blaze on being heated to a degree sufficient to fuse and make it red: it is sufficient, for this effect, to bring it in contact with the air, by removing the white oxyd or calx which covers it.

The Chinese perforate their coin for the purpose of stringing them on small cords.

M. Le Sage also analysed the silver which the Chinese employ in their jewellery, and found it alloyed with one half of copper.

Observations.—The great use made of zinc in China naturally suggests it as an article of commerce to that country. There are vast mines of its ore in England: would it not, therefore, be

worth while to make an experiment of working it here for that market? It seems, from their thinking it sufficiently valuable to form coin, that there might be a considerable profit on this trade: but, even if it were a moderate one, it would be very advantageous by adding to the small number of articles, which the Chinese take from this country, and proportionally diminishing the vast quantity of silver annually exported to that part of the world, to balance our imports thence.

On applying the Retention of Temperature of large Masses to diminish the Variation of Pendulums.

By Mr. J. Whitley Boswell.—*Phil. Journ.*

As bodies receive or communicate heat by their surfaces, and retain it in proportion to their bulk, the mutability of their temperature must depend on the ratio of their surfaces to their solid contents. As in large bodies the surfaces are less, in proportion to their solid contents than in small bodies, it follows that large bodies will vary less in their temperature: and as their variation of expansion and contraction depends on that of their temperature, it is also evident that large bodies will vary less in their dimensions.

The degree of the variation of dimension of bodies, depending on the ratio of their surfaces to their solid contents, can be regularly estimated, because it is known that the surfaces of bodies of similar figures are exactly as the squares, and the solid contents as the cubes of their diameters: and as the surface may be considered a counteractor to the power of the mass to retain temperature, the degree of this retention may be estimated in any bodies as their solid contents, *minus* the relative value of their surfaces; or as the cubes of their diameters, *minus* the squares of the same.

To shew how much the retention of temperature is increased by the greater bulk of bodies, the following table is given of the proportions of four cubes in all the before-mentioned respects, whose sides are reciprocally as 1, 2, 3, and 4, whence those of other bodies may be inferred:—

	Side.	Surface.	Change of Heat as	Bulk.	Capacity for Heat.	Retention of Heat estimated.
	Feet.	Square Feet.		Cub. Ft.		
A	1	6 .. 1	1	1	1	1
B	2	24 .. 4	4	8	8	4
C	3	54 .. 9	9	27	27	18
D	4	96 .. 16	16	64	64	48

The proportion of the surfaces of bodies to their bulk depends also on their figure: a globe has least surface in proportion to its mass of matter; a short cylinder, whose diameter is equal to its height, has less surface in proportion than a cube, and a cube than a parallelipiped.

From what has been premised altogether, it is evident, that the greater the bulk of any body, the less will be its mutability of temperature; and that a very large globe, short cylinder, or cube, will have its dimensions very little altered by the fluctuations of atmospherical temperature.

To apply the foregoing facts to the regulation of clocks, it is proposed to adopt the use either of the pendulum invented by Mr. Crossthwaite, of Dublin, or that contrived by Mr. Pine, (descriptions of which are to be found in the Repertory of Arts); both which have the power of making the variation of the pendulum-rod depend on that of the mass of matter to which the apparatus is fixed, though they do not contain self-regulating compensating principles, as the inventors supposed.

One of these pendulums, attached to a large block of granite or Portland stone, shaped either as a cube or cylinder, whichever would least diminish its original mass, would cause a clock to perform with little or no error from the change of temperature of the air.

Where stone cannot be had, a piece of well-seasoned straight-grained red deal balk, or solid mahogany, might be used for the same purpose.

The advantages of this method are, that it affords an unlimited mode of approximation to perfect compensation; and that it requires no great refinement of workmanship: it can be used in situations where it would be impossible to procure a gridiron pendulum.

On account of the many known impediments to the perfection of compound pendulums (some of which might be removed by forming them of simple metals, instead of the mixed metals now in use), it is proposed to try pendulums of other constructions.

Huygens's circular pendulum is recommended for experiment, and two or three others, on similar principles, contrived by Mr. Boswell. Huygens's pendulum consists of a ball suspended by a string, or chain, from the top of an upright circulating axle (which ball of course flies off by the centrifugal force from the axle). Its movement is rendered isynchronous, by a plate shaped of a paraboloidal form attached to the axle, along which the appending string comes in contact, and which thereby causes the ball to perform all its gyrations in a conoidal parabola, which, according to Mr. Huygens, will have this effect.

Those proposed by Mr. Boswell, instead of the plate and string, have rods, or troughs, projecting from the circulating axle, shaped in a parabolical curve, along which the regulating weight slides or rolls.

That with the parabolical rods is recommended as a regulator for mill-work, if made on a scale suitable to what it is required to perform.

Besides these, Mr. Boswell has also proposed, for experiment, a new oscillatory pendulum, consisting of a cylinder rolling on a cycloidal cavity; to apply which to a clock, it is only necessary to have an horizontal wire proceeding from each of the axes of the cylinder to the bottom of the pendulum-rod, and joined both to it and the axis. The generating circle of the cycloid used, should have its diameter half the length of a pendulum-rod on the usual construction.

The variations, from change of temperature, in this rolling pendulum, would merely proceed from the cycloidal curve, varying in size from this cause; and as this would be very minute in itself, and as the cycloidal checks of Huygens's clocks, which were subject to the same variation, were found to perform extremely well, it is presumed this would be a good mode of constructing pendulums: and, at all events, the changes that would take place in it from the foregoing cause, would be much less than those in common pendulum-rods, from their variation in length.

Madder Lake, a fine and durable Red.—Trans. Soc. Arts, &c.

Sir H. E. Englefield has procured a lake from madder of a very fine colour. He was induced to try experiments of this nature, on account of there being no red pigment in use sufficiently permanent; and he made trial of madder for this purpose, because it is known to furnish a dye less subject to change from exposure to the air, than other vegetable colours, and that all the madder lakes hitherto used, gave only a yellow red, or pale opaque pink, without clearness or depth of tint, which made them unfit for water-colours.

Process for this Lake.

Two ounces of the finest Dutch madder, called crop madder, should be enclosed in a bag capable of holding three or four times that quantity, and beaten in a marble mortar with a marble pestle, along with about a pint of cold soft water, which, when become very opaque, should be poured off, and fresh water put on; about five pints of water, in this manner, will extract all the colour.

The tinged water should then be put into a copper vessel well tinned, or one of earthenware (for the use of iron should be carefully avoided in the whole process), and heated till it just boils,

then poured into an earthen vessel, and an ounce troy of alum, dissolved in a pint of boiling soft water stirred well into it; after this, an ounce and a half of a saturated solution of mild vegetable alkali should be gently poured in, and the whole well stirred during the operation; it should then be left to settle, and when cold, the clear yellow liquor above the colour may be poured off; a quart of boiling soft water should then be well stirred in, and, when cool, the liquor separated by filtration through paper, in the usual way.

Boiling water should be poured on it in the filter, till it passes through of a light straw colour, and free from an alkaline taste.

The colour should then be dried gently, and will, when quite dry, weigh half an ounce, or a fourth of the weight of the used.

The above proportions of ingredients, and the whole process, Sir H. Englefield found the best, after many trials.

That in which the alkali was omitted, gave a dark dull red: the remaining liquor gave a fine rose-colour on the addition of alkali, but which was deficient in force and depth.

That in which hot water was used in the trituration, gave a darker colour, but of inferior tint, and less in quantity.

And that which was left to infuse for a few days, during which it fermented, gave, when treated as above described, a much lighter colour.

The Smyrna madder gives the finest colour, but less in quantity, which is owing to the great dryness of the root when it arrives here.

In a trial made with the fresh Dutch root, the colour was of a very beautiful quality; and this induces Sir H. Englefield to recommend the planting of madder, and extracting the colour in the large way from the fresh root for the use of dyers, by a similar process, wherein proper triturating mills and stampers should be used; for which he recommends the common cyder-mill in the first part of the preparation. In the common way of using this root, a great quantity of the colouring-matter is still left in it.

Various specimens of Dutch and Smyrna madder lake, prepared as described in the different trials, were presented to the Society of Arts, and one mixed with oil, and another with gum, prepared by Mr. Newman, together with testimonies in favour of the colour, from Messrs. West, Turnbull, Opie, Turner, Daniel, Hoppner, and from Mr. Cotman and Mr. Munn.

The gold medal was voted for this discovery to Sir H. E. Englefield.

On the Discovery of a Mine of Manganese, and some new Properties of this Mineral. By Dr. Wm. Dyce.—*Trans. Soc. Arts, &c.*

Dr. Wm. Dyce, of Aberdeen, has communicated to the Society of Arts the discovery of a mine of manganese in his vicinity, of great extent, and very fine quality. He thinks that the veins of this mineral commence at the banks of the Don, and run thence from south to north to the sea, where it is found in the form of a black sand, from which he thinks, with the other usual materials, a cheap glass might be produced. Having frequently found specimens of manganese in the interstices of granite rock, the Doctor uses this fact as an argument against the received opinion, "that where granite abounds, metals are not to be found." He sent a cask of the manganese to the Society of Arts, with some specimens of other minerals, the most remarkable of which was a piece of malleable iron, found in the centre of a lump of manganese oxyd. Dr. Dyce also communicated a singular use of manganese, which appears to be his discovery, and promises to be valuable, both in itself, and in the hints for similar applications of it, which it will probably suggest. It consists of a "Process for separating the pure from the base metals."

For this purpose two parts of powdered manganese (oxyd) are to be mixed with the impure or compound metal, which should be previously beaten out thin, and divided and cut into as small parts as possible, to expose the greater surface: the whole is then to be kept "in a sufficient heat," for a short time in a crucible; when it will be found converted into a brown powder. This powder is to be mixed with an equal portion of pounded glass, and then fused in a crucible, when the *perfect metals* will be found at the bottom in a state of "*extreme purity.*"

The Doctor mentions the following machine, which he used for washing the manganese, as enabling two men to do as much as ten without it: A hollow cylindrical vessel, fixed on an axis in a large trough (somewhat as a grinding-stone is) so as to revolve in water for the greater part of its bulk, is formed of small iron bars, nearly approaching each other, attached to two drum-heads; a small door is contrived on the surface of the cylinder, so as to close with an iron rod passed through two staples: the manganese, turned round in this for a few minutes, is completely separated from all foreign particles. The cylinder must be lifted out of the trough to empty its contents, which requires two men to perform it. Dr. Dyce thinks a lever or simple crane might easily be so fixed as to enable one man to do the same; he recommends the use of the implement for other purposes, particularly for cleaning feathers.

The gold medal of the Society of Arts was given for this discovery: certificates of the quality of the manganese being equal to the best American or Devonshire, and to that got from Lon-

sold at £10 per ton, were received from Messrs. Tenant, Knox, and Co. Glasgow, and Mr. James Ferguson, Aberdeen.

Observations.—The Doctor does not mention with what metals he tried the above separating process; but it is probable it was some alloy of gold or silver, as those are generally the metals called "perfect."

It is most likely this process might be useful in separating other metallic compounds also, particularly when one of the component parts was much more easily oxydated than the other; but experiment alone can determine this: at all events, this fact is highly valuable.

The discovery of the mine of manganese is of the more importance, since Monsieur Gaseran has found out that this mineral forms a component part of steel, and should be added to iron for its formation, best German steel being composed of—

Iron - -	96,84
Manganese -	2,16
Carbon - -	1, 0

The value of this mineral to various manufactures seems every year increasing, from the discoveries of its farther application to different arts.

Talc.—Trans. Soc. Arts, &c.

THE silver medal was voted, by the Society of Arts, to J. Machlachlan, Esq. of Calcutta, for his communication relative to this mineral, and the method of dying the Coromandel red. Mr. Machlachlan mentions that the hills in Bhar, and other parts of India, contain immense quantities of talc or mica, the same as what is commonly called Muscovy glass, of which the natives of India and China make very splendid lanterns, and other utensils, and also use it calcined in medicine, for cough and consumption. It is used in silvering the Indian paper for several purposes of ornament, and many other uses, not here specified. The price is there six rupees for the maund of 84 lb. split into sheets of two lines thick. Mr. Machlachlan thinks it might serve for many useful purposes here, and be brought over as ballast at a very small expense; a specimen of it which he sent, may be seen at the house of the Society.

The process for dying the red is something similar to that for dying the Turkish red, of which so many accounts have been lately published.

The matters used for preparing the cloth and making it take the colour, are lime, congee (a kind of starch), buffalo's milk, sheep-dung, gingelly oil, and ash-ley; and the colouring matters are chaya root, red wood (not described), and myrabolans or galls.

But as neither the chaya, red wood, nor gingelly oil, can be easily had here, it is imagined the farther detail of the process would be useless to any dyer in this country, especially as it is probable the chaya root, which is the principal dying ingredient, would lose much of its virtue, in the length of time which must elapse from its being gathered in India to its exposure for sale in an English market.

Improvement in Topography.—Trans. Soc. Arts, &c.

JOHN CHURCHMAN, Esq. (member of the Imperial Academy of Petersburgh), sent, to the Society of Arts, an account of an improvement in the construction of maps and charts, by drawing certain lines to represent horizontal sections of the country at different elevations; which elevations he proposes to have a mathematical relation to the distances at which those lines are placed asunder on the map, or else to denote a certain number of feet of elevation by the same distances.

By a similar method he proposes to describe the soundings of harbours, rivers, &c.

Thus, in the map of an island, if four of those circuitous lines should appear (which would thus somewhat resemble so many concentric circles), and that 100 feet were fixed on for each stage of elevation, then the highest part of the island would be understood to be 400 feet above the level of the sea.

In like manner, if the chart of a harbour had in it five of those circuitous lines, fixed at the soundings, which the addition of two fathom in succession for each line would produce, as they proceeded from shoal to deep water, then the greatest depth of water in the harbour would be understood to be ten fathoms. The silver medal of the Society was voted for this contrivance.

Observations.—This is a very ingenious improvement, but would be attended with much trouble and expense on a large scale. As particular circumstances would probably make it necessary to take different intervals of elevation for most maps done in this way, and the recollection of the mathematical proportions mentioned, would be troublesome both to the drawer of the map and the person who consulted it (notwithstanding the simplicity of those proportions). It appears to be better to follow Mr. Churchman's example (in the topographical plan sent in as a specimen) than his precept, and denote, by figures placed at every respective circumscribing line, the elevation which each was to represent above that immediately beneath, which would prevent all mistakes, and make the plan easily understood by every one at first glance of the eye.

A cheap Sea Dam.—Trans. Soc. Arts, &c.

THE Rev. Daniel Pape (late curate of Rye) received the gold medal, from the Society of Arts, for the improvement of Rye harbour, executed under his direction.

It has been long esteemed a great object to have a shelter for vessels near the Straits of Dover: and, before Ramsgate harbour was brought to its present perfection, large sums of money were laid out for the improvement of Rye harbour; but the sand thrown up by the sea has always been too powerful for the means used to prevent its accumulation: and, since the establishment of Ramsgate harbour, that of Rye has been found so inferior, and was reduced at last to such an unserviceable state, that the tonnage, which used to be paid to its trustees, by the ships passing, was, in 1795, transferred by the Trinity-House Board, to the use of Ramsgate harbour. There was, however, a sum of £6000 left in the hands of the Rye trustees, with which they determined to make another attempt at rendering the harbour serviceable, and accordingly advertised for plans for this purpose: two were proposed at the appointed time, one of which Mr. Pape states to have been impracticable, and his own to have appeared so unlikely to succeed, that he was obliged to take the whole risk of the attempt on himself, before the trustees would consent to put it in execution.

The natural course of the river, or estuary, at Rye, runs round a narrow neck of land before it discharges itself into the sea, and is much narrower across at the point of this neck than farther up; and the bar, having formed about this position, left deep water as usual above it, to which it was Mr. Pape's object to make a passage free to the sea; his plan for which was to cut through the neck of land a new channel, and to close up by *a dam of cheap structure* the former passage over the bar, in order to force all the water in the new direction.

This dam was formed in its lower part in two parallel ridges close to each other, like the double roof of a house, which were covered over first with straw and then with hazel faggots about thirteen feet long; and the whole was well pinned down with piles, which were united to each other at their heads by pieces put across the direction of the faggots, which seem from the plate to have lain at right angles to the line of the bank: when this was so far completed, Mr. Pape formed another bank, on the top of this, by filling up the interval between the two ridges, and covering the whole in the same manner as described. It was necessary, Mr. P. observes, to do all this in one tide, and to have the new cut ready to open at the same time; all which was exe-

cuted with exactness, and complete success: for, though before this improvement vessels of fifty tons could not come in without difficulty, ships of two hundred and fifty and even three hundred tons can now get in at spring tides, so much has the new cut deepened the channel.

The new cut and dam were executed in three months in the winter season; for his trouble in directing which work, Mr. Pape states to have received but twenty-five guineas clear, after paying his assistant: the expence of the work was only four hundred and eighty pounds.

A pier-head on the east of the new cut, and two jetties to the west, were afterwards added by Mr. Pape's recommendation, to secure the cut from reverting to the former state: this part of the work cost three thousand pounds, and was executed in a very masterly manner by Mr. Sutherland, who, it is to be hoped, had something more for his trouble than Mr. Pape had for his; who, without considering his time or trouble, which was certainly considerable, or his invention, which also demands recompense, is every way entitled to proper remuneration for the great public benefit, procured by his exertions, of a harbour in this situation, if it even should prove of temporary advantage; but if it permanently remains in its present state, the public advantage will be immense.

Observations.—The method of forming the dam in such a cheap and yet effectual manner, deserves chiefly to be noticed here, affording an example of high value for works in similar situations.

We are sorry to be of opinion that this improvement of the harbour, however beneficial for the present, will not long continue so: all the various plans which have been tried on this harbour, have at first performed well, as this does now; but before long (notwithstanding some of them were directed by engineers of the greatest abilities) new bars began to form in the new entrances, and in the end the sands prevailed over all.

The example of Ramsgate harbour, and the complete success of the means used for preserving its depth, (at no great distance from Rye,) it seems, should make it clear to the trustees what steps to pursue to obtain the same advantages for their own harbour. The harbours also of Ostend and Dunkirk, there is reason to believe, are kept clear by similar methods. If, however, there should be something in the nature of the situation of Rye harbour, that renders these methods impracticable, or the trustees should not choose to adopt them, it is no great presumption to predict, that all temporary expedients will ultimately fail of success; and every thing short of these measures must be considered as such.

As far as can be judged of the situation of Rye from a map, it seems much better posited than Ramsgate for the execution of the works necessary to continue a permanent depth of water at

a cheap rate. So that it seems to rest with the trustees, whether they will have a proper harbour there or not, or with those who should supply them with adequate sums for this purpose.

Machine for Grinding Colours.—Trans. Soc. Arts, &c.

Mr. James Rawlinson, of Derby, presented a model of this machine, to the Society of Arts, for which he received the silver medal and ten guineas. He used the machine for several years, and has found it much more effectual and expeditious in reducing the colour to extreme fineness, than the usual method, and much less injurious to the health of the workman, who frequently has done as much with it in three hours as he could in twelve with the muller and slab.

The machine consists of a flat cylinder of black marble, sixteen inches and a half diameter, and four and a half thickness, with an axle traversing its centre, (thus somewhat resembling a common cutler's grindstone). It is suspended on a similar frame, in a vertical position, and turned round in the same manner by a winch: a concave piece of marble is provided of the same breadth as the circular stone, forming a segment of the same circle one third of the circumference in extent: this, which may be considered as the muller, is fitted into a piece of solid wood of similar shape, one end of which is secured loosely by a hinge or otherwise to the frame; the other end, rising over the circular stone and supported by it, is farther pressed down on it by a long spring bent over from the opposite extremity of the stand, and regulated as to its pressure by a screw, whose end turns against the concave muller: a slight frame of iron in front, moveable on a hinge, by which it is secured to the frame, supports a scraper, for taking off the colour, formed of a piece of watch-spring, which is turned back out of the way when not in use. Mr. R. thinks the circular grindstones might be made much larger than that he used, to advantage, and that one of two feet diameter would not occasion too much labour to one man to turn it: he computes that in this machine there are seventy square inches of surface of the concave muller in constant work on the paint, while in the common muller not more than sixteen square inches are usually in contact with the slab. The machine will be found equally serviceable for the colours ground in water as for those prepared with oil, according to Mr. R., who highly recommends its use to all colourmen.

Mr. R. advises, in making up the colours in bladders, to insert a bit of quill or reed in the neck of the bladder, which will thus bind better in tying; and, admitting of a secure stopper, will be more cleanly and less wasteful than the usual method of stopping with a nail, and keep the colour more safe from the air.

Easy Method of shifting Ship-blocks.—Trans. Soc. Arts, &c.

The gold medal of the Society of Arts was voted to Mr. Robert Seppings, of Chatham Yard, for his method of constructing blocks, to support the keels of ships, so that they can be easily shifted or removed.

This contrivance consists of a block about five feet long, sloped beneath from the centre to both extremities in an angle of five degrees and a half, so as to form two inclined planes, between which and the bottom of the dock a wedge is inserted at each side, each of which wedges is about three feet in length (from the scale), and formed of cast iron, with the acute angle of five degrees and a half; the sloped bottom of the block is fortified with a plate of wrought iron half an inch thick; and the bottom of the dock has also a plate of iron three quarters of an inch thick in the wake of each block, so that the iron wedges act against iron both above and below.

The ship, being placed on blocks of this construction, is to be well supported by proper shores when the blocks are to be shifted; after which the wedges are knocked out by battering-rams, striking their heads obliquely at each side alternately, in the manner which common wedges are usually loosened with a mall.

Mr. S. found the battering-rams much improved, and the work greatly facilitated to the men, by having two small wheels (fixed near the striking part of the ram, about thirteen inches diameter each): the blows were given by these rams with more exactness, and they were found particularly serviceable in replacing those wedge-blocks again under the keel, when the work was completed for which they were removed.

The action of the wedges was sufficiently powerful to raise a ship from her shores. The battering-rams seem (from the drawing) to be about twelve feet long, and to have had eight men to work each of them, as that number of cords are attached to each, to move them by.

A dock was fitted at Plymouth for the use of these blocks, in August 1801; and the contrivance was found to be so serviceable, that, after other docks had been fitted up at Sheerness and Portsmouth with similar success, directions were given in 1808 for the general use of Mr. Seppings's wedge-blocks in all his Majesty's yards.

With these blocks twenty men are sufficient to suspend a first-rate man of war: the operation of lifting in the common method would require no less than five hundred men, which is a vast saving of labour: besides this, the use of the wedge-blocks saves much time, which is the more important, as the saving of a day often prevents the loss of a spring tide, by which a fortnight is gained; which in war time is of a consequence that cannot be sufficiently estimated.

Captain Wells, of the Glory, 98 guns, had fids constructed for the top-gallant mast of that ship, on the same principle: Mr. Seppings, also, tried the same in other ships, and they were found to answer perfectly well in every respect.

The part of the top-gallant mast which rested on the fid, was formed with a double slope (in the same manner as described in the account of the blocks). The half of the upper part of the fid, from the middle to the extremity, was cut so as to form it like a wedge: when in its place, another wedge was driven in between its other half and the top-mast in the mortice, and this wedge was secured to the fid by a pin, which went through both. By fidding the top-gallant masts in this manner, they can be struck at the shortest notice, without slacking the rigging, which frequently might save them from being sprung and carried away. The angle for the mast wedges should be about 20 degrees.

Improved Gun-Lock.—Trans. Soc. Arts, &c.

Mr. GEORGE DODD, of Duke-street, Portland-place, presented to the Society of Arts a gun-lock, so formed, that it could not, by any accident, go off at half-cock (as, the more forcibly the trigger was pulled, the more would it impel the catch of the sear into the cavity of the tumbler); and in which, also, the danger of missing fire, by the tumbler catching at half-cock, was prevented, by the sear being so contrived as to be kept back by the trigger, till the half-cock cavity had entirely passed it. By these means, fire-arms may be rendered more certainly efficacious, and less liable to occasional accidents, in a simpler and less expensive manner, than by most methods before used for these purposes.

The above effects are produced, principally, by the shape and position of the sear and trigger. The tail of the sear hangs nearly in a perpendicular line over the back of the trigger, which, in that part, is formed into a double slope beneath it, the highest part of which is directly under the face of the sear. At half-cock, the posterior slope of the trigger presses against the tail of the sear, which, thus tending to force it back, causes the catch of the sear (which moves in a contrary direction from the tail, at the opposite side of the pivot) to press more strongly against the tumbler.

But, when the lock is in full cock, the tail of the sear rests against the *anterior* slope of the trigger; and, when snapped off, it cannot pass the ridge of the trigger to regain its first position, before the half-cock cavity of the tumbler has entirely passed beyond the line of the sear-catch.

Mr. Dodd obtained the silver medal, and ten guineas, for this invention from the Society of Arts.

Implement to enable Shoemakers to work in a standing Posture. Invented by Mr. Thos. Holden.—Trans. Soc. Arts, &c.

Fifteen guineas were given to Mr. Thos. Holden, of Fettleworth, Sussex, by the Society of Arts, for contriving this implement.

It resembles a stand such as is used for reading-desks: at the top of which is a small block of wood, excavated so as to form a proper bed for the last, and the moulds or instruments used in making boots, which are kept firm upon it, by a stirrup or endless strap.

The hollow block is joined into another piece (which connects it to the stand), so as to admit of a vertical motion; and it is retained, at any angle, in this motion, by a circular catch, with notches formed in its side, to fasten it on an iron catch projecting from the lower piece. This lower piece is shaped into a small cylinder beneath, which entering into a hole formed for it in the top of the pillar of the stand, permits the hollow block to be moved round about, without stirring the stand; so that, by the combination of these two motions, it may be placed in any position.

Behind the hollow block, and on a level with it, an horizontal piece of board is supported by a small pillar, rising from one of the feet of the stand, and secured firm by a brace to the stand itself; this board supports the tools and implements wanted, ready at hand for the workman's use.

The design of this invention is to obviate the necessity of using that very unwholesome posture in which shoemakers are accustomed to work; which compresses the lungs and bowels in such a manner, as to occasion consumption, inflammation of bowels, and a variety of other frightful complaints.

The efficacy of the alteration of posture permitted by this instrument, which enables the workman to stand at his work, is very well proved in the case of the inventor of it; who has produced a medical certificate, that he was, for many years, so afflicted with bowel complaints and piles, that he was under the necessity to leave off his trade entirely, if he could not contrive to work standing; and that, since he has made use of this implement, his complaints are entirely removed, and he is so improved in flesh and countenance, that he "looks not like the same man;" and, for some years, has had no occasion for medicine. He has made many hundred pair of shoes on this stand, and recommends also its use, as "the quickest way of closing all the thread-work."

Observations.—This implement might be made still more simple, by leaving out the part used to give the hollow block a circular motion, which does not appear necessary, from the facility which the workman has, when standing at it, to place himself instantly

at any side of his work he pleases; and it seems, therefore, it would be full as little, or rather less, trouble to him to let the instrument remain unmoved, and turn himself round instead of it, as to stand still while he turned it about.

A wooden vice, of a proper height, fixed to a stake, and secured even by a wedge, if a screw should be deemed expensive, would also hold a last in any position required for the workman.

These circumstances are mentioned, because the invention is highly valuable, and whatever can tend to render it cheaper, or enable the workman to procure other instruments for this purpose, which chance might render more easy to acquire, or his fancy make more agreeable, must be of use.

It would be a matter of great humanity to persuade other orders of workmen as well as shoemakers to work in postures less injurious to their health than those they are in the habit of using, some of whom use them without any apparent reason: for instance, tailors, who could full as well perform their work standing or sitting before a table which supported it, as by coiling themselves up into a form equally preposterous and useless, and still more injurious than that used by shoemakers, as it compresses and deranges all the vital parts still more, while at the same time it cripples their limbs in the manner that causes that peculiarity of gait for which they are ridiculed. But such is the force of custom, that sickness, pain, and ridicule are endured, rather than change a useless posture, which nothing but the total absence of chairs and tables can excuse, and which can now serve no purpose but to prove the antiquity of the profession to have preceded the invention of furniture: but, as this is a point no one will dispute, it is to be hoped some of them will have sense enough to lay it aside; and that some masters may be induced to provide tables at which men might work either sitting or standing, as they chose; who would find their account in this piece of humanity, both in having the work less interrupted by change of hands, in keeping it more clean, and probably also in other particulars. Much might be added also here, with propriety, as to the humanity of having work-shops of all kinds, where many men work together, better ventilated and larger, to improve the health of workmen, but that it is feared the observations on this subject will be thought already too much extended.

Simple and cheap Repeating Watch.—Trans. Soc. Arts.

Mr. Elliot, of Aylesbury-street, Clerkenwell, received thirty guineas, from the Society of Arts, for his invention of a repeating-watch, in which the motion is performed with much fewer parts than in any other, by which he is enabled to reduce the

price so low as eight guineas for a good repeater on this principle, or to add the repeating-work to another watch for three.

The method by which this repeater is so much simplified, is by the use of a single part, which is so contrived as to perform the operations of several: this is, a flat ring, or centreless wheel, of nearly the same diameter as the watch, supported in its place, so as to admit of circular motion, by four grooved pullies placed round its external circumference, in the same manner as the part in common clocks which denotes the moon's age. This part is put in motion by turning the pendant, whose extremity is formed into a small vertical wheel, which works in teeth cut on the external part of the flat ring for almost a third of its circumference. The lower part of the ring contains the pins, at right angles to its face, which lift the hammers for striking the hours and quarters; the internal part of the ring contains indentations of regularly increasing depths, which, receiving the tails of the levers, whose other extremities are pressed by their springs against the hour-snail and the quarter-snail, is by them prevented from moving beyond a certain degree proper for the time: after the pendant is turned, the ring is brought back to its first position, by a box-spring, round wich a fine chain is coiled, whose extremity is connected with the inner part of the ring.

By turning the pendant to the left the hour is struck, and by turning it to the right the quarters are repeated; and the returning spring just mentioned, is made to operate in both directions, by its chain passing between two little pullies, which on either side convert the direction of the chain to the line of traction of the spring.

By this it is evident this single flat ring performs all the following operations.

1. It receives the motion for striking the hour from the pendant.
2. — The same for striking the quarters.
3. It carries the pins, or teeth, which lift the hour-hammer.
4. — The same for the quarter-hammer.
5. It contains the indentations by which the hour-snail operates on it by its lever.
6. — The same, by which the quarter-snail operates on it.
7. It carries the part that recoils the movement which tells the hour, to its first position.
8. It carries the part, for the same purpose, for the quarter-movement.
9. It contains a cavity, which moves over a fixed pin, that prevents the pendant from turning it too far.

In this ring, the same parts, in three instances, are made to perform double operations, by which simplicity of construction is farther advanced.

Observations.—It is by simplifying engines, by making fewer parts perform an operation *equally well*, that true mechanical know-

ledge is evinced. Those who first attempt the composition of new engines, and in general all ignorant mechanists, think the more wheels, levers, pullies and springs they put in an engine, the more they add to its efficacy and beauty; and, some in this way go so far that they bewilder themselves, and, imagining a sort of magical power inherent in wheels and springs, presume that a certain quantity of them is the only requisite to produce more than a perpetual motion, that is a power so increased in both *force* and *speed*, as greatly to exceed that of the first mover in both particulars.

But in the instance here described, the power of simplifying seems to be carried to its greatest extent, without in the least injuring the efficacy of the engine; by which a masterly contrivance is shewn, that reflects the greatest honour on the inventor. Indeed the invention, in this respect, is carried to such perfection, that it would tempt one to pronounce, that it is impossible to farther simplify repeating-work, if it was proper for the limited knowledge of man to define the bounds of possibility.

Improved Safety-Valve.—Trans. Soc. Arts, &c.

THE silver medal of the Society of Arts was voted to Chevalier A. N. Edelcrantz, by the Society of Arts, for an improved safety-valve for steam-engines, which is contrived to operate so as to regulate both internal and external pressure.

The principle of it is the uniting two valves in one, or placing a second valve on the common safety-valve.

The safety-valve, which opens from within outwards, has a cylindrical rod projecting from its centre downwards, on which the socket of a second valve slides smoothly, but perfectly air-tight; which is pressed up against the bottom of the first valve by a spiral spring, whose lower extremity rests on a nut screwed to the bottom of the rod. The surfaces in contact of the two valves are ground so as to touch quite close, and three or more perforations are made through the upper valve, so as to admit the action of the atmosphere on the lower valve, but of that size which leaves a sufficient part of both valves in contact, and substance enough between these apertures to firmly support the cylindrical rod.

Observations.—The advantage of this contrivance is, that it occasions but one perforation in the boiler for the two valves, and may save several parts of the apparatus necessary for fitting up two separate valves. The only objection is the difficulty of regulating the pressure of the spring to the proper degree; as, from its position, it is not easily come at, and that a spring, in a place so exposed to change of temperature and moisture, would soon go out of order; but if it should be found of much benefit to use a double valve, it would not be very difficult to contrive

the same effect to be produced by a weight as by the spring, and even to have that weight outside, and make it act also in keeping the other valve down with sufficient force; which might be done by making the cylindrical rod proceed from the lower valve, instead of the upper, and make it pass upwards through a socket in the upper valve; to the upper part of which socket two small pullies should be fastened, over which two chains or cords should pass from the rod of the lower valve to a circular weight, perforated so as to slide freely up and down the socket of the upper valve. This weight would then both act to press the upper valve down, and also, by the chains over the pullies, to pull up the lower valve: the socket might be cut at either side downwards to form a receptacle for the part of the chains that had passed the pullies, or grooves might be cut for them in the rod.

Chev. Edelcrantz mentions, "that he found red copper the best to form the piston with, when the cylinder in which it was to work was of brass; for that the expansion of the first being to that of the latter nearly as 10 to 11, the superior temperature of the piston was thus compensated by the inferiority of its expansive power."

On exhibiting the Electricity of Metals without the help of any Condensing Instrument.

By Mr. Wm. Wilson.—*Phil. Journ.*

Mr. Wilson, when preparing to repeat the experiments of Cavallo, relative to the electricity obtained by the contact of metals, was induced, from certain circumstances he had observed, to suspect that it was not the actual contact of the metals which produced electrical signs, but the separation of the metals from the contact.

It appearing evident to Mr. Wilson, that if the contact was the cause of electrical signs, the whole of the effect would be produced, however few the points of contact were; but that if the separation was the cause, the more extensive the contact was, the more powerful would be the signs of electricity on separating the metals, he conceived it would be a good method, to put this to the test of experiment, to sift filings of another metal through a copper sieve, formed by a thin sheet of copper pierced full of small holes, just large enough to permit two or three particles to pass at once, so that the surface of contact should be very great with a small quantity of metal.

Half an ounce of zinc filings sifted in this manner on the cap of an electrometer, produced a divergence of the gold leaves of near an inch; which induced Mr. Wilson to try sieves of other metals, with various metallic filings: the result of which expe-

riments are inserted in the following table, where P stands for positive electricity, N for negative, 0 for the absence of effect, S for strong, W for weak, V for excess of either, or the word very, and M for middling.

As in all those experiments there was a large surface of contact, and the electrometer only was used; but, in those made by Cavallo and others, where the contact was small, electrical signs could not be made to appear without doublers and multipliers of electricity; Mr. Wilson thinks there cannot be a doubt of those signs being caused in his experiments by the separation of the metals from contact:—

Filings of	Sifted through				
	Copper.	Tin.	Silver.	Zinc.	Lead.
Copper - - -	0	N. s	0	N. s	N.
Zinc - - - -	P. s	0	P. s	P. v w	0
Tin - - - - -	P. M s	N. v w	P. s	0	N. w
Silver - - -	0	N. w	0	N.	
Steel - - - -	N. v s	N.	N.	N.	N.
Lead - - - -	P. v s	0	P. v s	P. M s	0
Brass - - - -	P. v s	N. s	P. s	0	N.
Bismuth - - -	P. v s	0	P. v s	P. s	N.
Antimony - -	0	N. v s	P. s	N. s	N. v s
Nickel - - -	P. v s	0	P. s	0	P.

On Extinguishing accidental Fires in Ships.

By Mr. ALEXANDER TILLOCH.—*Phil. Mag.*

Mr. TILLOCH begins his paper on this subject by some account of the theory of combustion, in which he takes occasion to state, that fire is more supplied from the oxygen of the air than from the combustible body, and that water may itself act as an inciter to fire, instead of extinguishing it, when exposed to

a sufficient temperature, in circumstances which shall decompose it into its constituent gases, hydrogen, a combustible, and oxygen the only supporter of flame.

Mr. Tilloch states, also, that water acts as an extinguisher, *merely* by interposing itself between the flame and the air, and excluding the latter, thus acting "as a wall of separation between the burning materials and the atmosphere:" for this reason he recommends mixing sand, or mould, or clay, with the water employed to extinguish fire, to render its effect in this respect more powerful.

Mr. Tilloch strongly states the superior efficacy of cutting off all communication between the burning bodies and the atmosphere, as the most certain means of stopping conflagration: wherefore, when this takes place in a ship, the hatches should be closed, and all hands employed in stopping every crevice, by which the air could pass to the burning body, with oakum or any other matter: by which means the ship would become "one large extinguisher," and the fire go out when it had consumed the oxygen of the confined air. By this method, if the fire forced its way through the lower deck, it might be stopped in the second deck, by closing the ports, hatches, and all other apertures belonging to it in every direction.

To hasten the consumption of the oxygen of the confined air, Mr. Tilloch recommends, before closing the hatches, to light as many other fires below, in pots, pans, and other vessels, as time will permit, and also to light up as many candles as possible, each of which consuming a gallon of air in a minute, will assist in sooner rendering the enclosed air unfit for combustion.

Mr. Tilloch also proposes, that a quantity of chalk or lime-stone should be stowed on board, and also an adequate proportion of vitriolic acid; by means of which a quantity of fixed air might be produced which would also assist in extinguishing the fire.

When the flames are stopped by these means, caution must be used to carefully ventilate all the enclosed places by every possible means, before the men are suffered to go down, as otherwise their instant suffocation must ensue.

When a fire takes place above deck, the use of water mixed with sand or mould, is recommended; and the strewing sand on the decks, three inches thick, both to stop and prevent fire in that part, and to form a road by which the men can get at the burning body, so as to apply mops wet with the above mixture to it, which Mr. Tilloch thinks would be more effectual than the effect of a fire-engine: in this operation, the application of the mop should proceed from below upwards.

It is also advised to separate the part of the ship where fires are most likely to originate, from the rest, by air-tight partitions (or bulk-heads), so that when a fire happened there, it would be only necessary to close and caulk up the entrance to this part to put it out.

It is also recommended to cover all the upper works with sheet-copper, to prevent their taking fire by any accident which might happen on deck, and to enclose the masts in the same manner, having metallic chains added along the shrouds, to secure them in case of the rigging being burned away.

Observations.—There are some matters in this paper which will appear so chimerical to a nautical man, as to make him set much less value on the rest than they deserve: but still, as every thing which may assist to subdue so dreadful an enemy as fire at sea should be known, and as even discussion on this subject may be of use, the benevolent views of the author should be made as public as possible.

Water certainly operates to extinguish fire, by excluding the air; but then it is not the only way in which it acts for this purpose: it puts out fire *by cooling the burning body* also, or (to use the mode of expression adopted in the original paper), by abstracting caloric from it, in passing to the state of vapour, which is thought, by most, to be the chief way in which water puts out fire; therefore, it would be useful to throw water, not only on the burning wood, but on that which was growing hot.

The sand and earth recommended to be brought on board to be mixed with the water, would, unless stowed on deck, be useless, for there would not be time to hoist them from below in case of fire. The rolling of the ship at sea, would make it impossible to strew the deck three inches thick with sand, as advised; and the stowage it would take up any where would be objected to: the same objection would hold against the chalk and vitriol acid to produce fixed air, to say nothing of the impossibility of producing this gas by these means, sufficiently speedy and abundant to be of any great use; and, to a sailor, the very proposal of the method would appear so absurd, that he could be hardly induced even to make a trial of it.

What is said of closing all passages, from the burning bodies to the atmosphere, cannot be too much enforced: this, sailors would agree to readily, and, in a great measure, already are aware of. If time would permit, and if the fire-vessels could be properly secured from doing mischief, it would also be useful to light more fires below, before closing up; but confusion occasioned by the fire, would probably make this a dangerous attempt, and it would be such as sailors would not readily come into: nevertheless, the idea seems so good, that the proposal of a farther extension of it shall be here ventured on a more enlarged scale; which is, to have one or more hatches constructed with well-fitting valves opening upwards; and before closing up, when a fire below could not be subdued by effusion of water, to lay a train of gunpowder, with a slow match, in such a manner as to set fire to it after the valve-hatches were laid down; the effect of the explosion of the gunpowder would be, not only to consume

a considerable part of the oxygen of the enclosed air, but also to blow out a large portion of it through the valves, which would, from its speedy operation in destroying and removing this vital support of fire, tend to make the latter cease in perhaps the most effectual manner. It would be no difficulty to lay the train of gunpowder so that it would go off in succession, and in such moderate proportions as would in no wise risk blowing up the deck: and, indeed, saucisses of gunpowder, such as are used in military mining, might easily be prepared on board for this purpose, to have ready when wanted. Though this seems a nicer operation than the other, yet sailors are so much used to manage gunpowder, and so well aware of its powers, that it is probable they would have no great objection to make trial of it.

The dividing particular parts of the ship from the rest, which has often been recommended by others before, would be of excellent service, not only for facilitating the extinction of fire, but in preventing danger from leaks, and strengthening the ship: but yet, such is the aversion of seamen to all divisions of the hold, that it is to be feared no plan of this kind will ever be adopted.

To the covering the upper works with sheet-copper, the expense would be a material objection; and it would be of little avail, if the decks were not coated also: but this would render them too slippery for the sailors to stand on them except in calm weather.

When a fire took place in the lower part of a ship, the method of extinguishing, by excluding the air, might probably be effectual; but, if this happened on the gun-decks of a vessel, it is feared that the number of ports, and other passages for air, to be closed, would render the attempt mostly unsuccessful.

It should, however, be tried at all events, as the least chance of relief is of consequence in such desperate circumstances.

A Method of ascertaining the Tonnage of Ships hydrostatically.

By Mr. J. Whitley Boswell.—*Rep. Arts.*

The common method of calculating the tonnage of ships being allowed to be very inaccurate, a number of other means have been proposed for this purpose, some consisting of different modes of measurement, of which Admiral Chapman's is generally esteemed the best, some of various mechanical methods, and one, by forming a vessel entirely according to regular geometrical curves, in all its different sections.

Five mechanical methods, for this purpose, are enumerated: in the first, tonnage is found by floating the vessel into a regular-shaped dock, drawing off all the water, and filling the dock again

from a reservoir (which held just enough to fill the dock to a certain height); then, by remarking how far the water rose above that level, to calculate the tonnage.

In the second method, a large square floating cassoon is used for the same purpose, in which the vessel is placed, the gates closed, the water poured out, and then, by the draught of the cassoon, the tonnage of the contained vessel is ascertained.

The third method is the first in miniature, performing the same operation with a model of the ship, formed according to a regular scale, and a cistern, as is effected in the first, by the ship itself and the dock.

The fourth method, is to fill the ship with water, and pump it out into vessels which hold a certain proportion of a ton.

And the fifth method, is to find the tonnage by loading the vessel with a weighed cargo, or with actual weights.

The two first methods would be very expensive, both in preparation and execution, and very difficult to be performed accurately; the third would be liable to great error, and very troublesome and tedious in the performance; and the fourth and fifth would be very laborious, and of course costly, for vessels of any considerable size.

The new method, proposed in this paper, which appears not to be liable to those objections, is founded on the different draught which a ship will have in salt water, and in fresh water, or water less salt.

This is a circumstance with which every seaman is well acquainted, and many have even witnessed the sinking of bodies in fresh water, which floated very well in salt water. It proceeds from the difference of the specific gravities of the salt water and the fresh, which is usually computed as that between 1037 and 1000, which is equal to a twenty-seventh (within a minute fraction) in favour of the salt water.

The proceedings for ascertaining the tonnage on these principles, differ a little according to the priority of the use of the fresh or the salt water, in the examination of the difference of draught of the ship in each.

If the draught in the salt water be first noted, then it is directed to mark carefully on the stem and stern posts, the height to which the water rises, by driving a nail, or other pointed instrument, at the exact water-line: after this, the vessel is to be floated into fresh water, on which the draught will be increased, and the marks covered more or fewer inches, in proportion to the draught of the vessel; then to take out part of the cargo of the ship, either into a lighter or on shore, which will cause the vessel to rise; and when enough is taken out to bring the marks again to a level with the surface of the water, then weigh the part of the cargo taken out, which can be no very troublesome proceeding, as it will not exceed three or four per cent of the weight of the whole cargo: after this, ascertain the difference of the

difference of the specific gravities of the fresh and salt water, by carefully weighing the same measure full of each in accurate scales, if it has not been done previously.

By these operations, the actual weight of the difference of gravity of the ship in fresh and salt water will be ascertained, and also the proportion which this difference bears to the weight of the whole ship: whence the weight of the cargo may be determined by the following calculation:—

Divide the weight of the measure of fresh water by the difference of the gravity of it, and that of the same measure of salt water; and, by the quotient of this, multiply the weight of the part of the cargo taken out; the result will produce the weight of the whole ship and cargo.

From this, the weight of the cargo may be found, by deducting from the whole weight of ship and cargo, the weight of the ship when empty, which may be ascertained by the process described, when the cargo is taken out; and this will give the tonnage of the ship, if she were loaded to her load-water line, as she should be.

If the draught of the ship in fresh water be first examined, it will be necessary, when it is floated into the salt water, to put on board additional loading, to depress her to her former level in the fresh water. This additional loading being weighed, the same proceedings and mode of calculation, already described, will ascertain the tonnage.

To make the method more clearly intelligible, an example of calculation is given: suppose the measure, containing a cubic foot (in which the water is weighed, to ascertain its specific gravity), holds 1000 ounces of fresh water, or 1037 of salt water, and that the part of the cargo moved from or to the ship (to bring it to the same level in both kinds of water), was found to be ten tons:

Then divide 1000 (the weight of the fresh water) by 37 (the difference of the gravity of the fresh and salt water): this will produce $27\frac{1}{37}$; which multiply by ten tons (the weight of the moved part of the cargo) and you will have $270\frac{10}{37}$, for the weight of the whole ship and cargo: from which deduct the weight of the ship when empty, (which suppose was found to be $70\frac{10}{37}$ tons), and the remainder, 200 tons, will be the tonnage of the ship.

If a roughness of the water should make it difficult to ascertain the exact draught of the ship; this may be remedied by using a small bent tube passed through a trenail hole below water mark, near the middle of the ship, and rising a foot or eighteen inches above the level of the water; a small float sustaining a light index put into this tube, will show the level of the external water very little affected by its roughness.

Every river of any note communicating with the sea affords situations for examining the tonnage of ships in this manner: but the most convenient place for this, is where there is a floating

dock near the sea, which either is, or can be occasionally, filled with fresh water. If this method should ever come into use, it might be expedient to have a few tons of iron ballast in such situations, each piece of which should be cast of the same weight, to facilitate the computation of the weight of the moved part of the cargo.

The difference of the draught in fresh and salt water will be about a twenty-seventh of the whole draught of the ship, which will be from 4 to 6 inches in vessels of 14 feet draught, and more in proportion in those of greater depth. This difference will be sufficiently conspicuous; but if it be desired to render it more so, the same methods used for multiplying the effect of the rise and fall of mercury in barometers might be applied to the bent tube, before described, for this purpose.

Account of the Performance of the Ship ECONOMY, *built according to Mr.* JOHN WHITLEY BOSWELL'S *Patent.—Rep. Arts.*

THE construction of this ship is described in the Repertory of Arts, Vol. 1st, new Series, page 430. Its design is to enable the builder to use much smaller and straighter timber than is usual, with equal strength, and to supersede the use of knees: by which the increasing scarcity of large ship-timber, so dangerous to a nation whose chief strength is in its navy, may in future be entirely remedied. The following account of the performance of this ship at sea, will no doubt be interesting to those who know the importance of improvements of this nature in naval architecture.

Extract of a Letter from Capt. Alex. Smith, Commander of the Economy, to William Lushington, Esq. part owner.

SIR, *Grenada.*

I have the pleasure to inform you of the ship Economy's safe arrival here, with convoy, yesterday evening. We had one gale of wind on our passage. The ship performs as well as it is possible for a ship, is remarkably easy at sea, steers and sails well, and is perfectly tight. In the gale of wind the Epervier man of war sprung her foremast; the Robert Aylward, ditto; a brig (master or brig named Swinger), lost both her top-masts, and parted convoy in lat. 14. 39. N. Our ship behaved extremely well, and never strained a rope-yarn.

(Signed) ALEX. SMITH.

Besides having these good qualities, the ship sails remarkably fast; as a proof of which, having been detained in the Thames, for part of her outfit for twenty-four hours after the West-India convoy sailed (when outward-bound), she afterwards passed by

most of them before they reached Portsmouth, and was one of the first vessels which arrived in Portsmouth harbour.

Mr. Boswell adds to this account, that he can point out improvements on the construction, within the limits of his patent, since the building of this vessel, so as to make it more convenient for stowage, and in other respects better.

Observations on Mr. JOHN SLATER'*s Patent for forming the Rigging and Cables of Ships of Metal Chains.—Rep. Arts.*

MR. SLATER obtained this patent in January, 1804; the title is a sufficient description of his object.

The design is no doubt a good one; some experienced captains of ships have mentioned it as such long before the patent was obtained. It is even better perhaps than the patentee is aware, as in all probability even the first cost would be less for standing rigging of chain than of hemp, from the high price of this latter article. The chief objection is, that the chain is not sufficiently elastic for standing rigging; but it is very possible to obviate this by the addition of properly-constructed springs; and some degree of elasticity may be given to the chain itself, by forming it with spiral links. The danger from lightning might be easily removed by proper conductors, as Mr. Slater observes.

It is the opinion of an experienced captain, that iron chain shrouds should be served with old canvas well greased, and spun-yarn; this would keep them from rusting, and make them more convenient to handle to the men. Mr. Slater does not propose the use of chain for running rigging; and probably it would be best to use hemp lanyards also: but while the design is mentioned as very beneficial, it is proper at the same time to observe, that Mr. Slater's patent cannot extend to the use of chain, either in the place of cables, or for slinging yards; for both which purposes it has been employed beyond the memory of man. Mooring-chains are to be found every where; and several ships bring out chain to moor by, to save their hempen cables, which is a very good and economical practice. West-India ships often have their lower yards slung with chain; naval ships have always had chain in addition to the hempen slings, and no doubt other ships also. A West-India captain has slung the three lower yards of his ship with chain, in a new method, by which they were much more moveable, and would go about farther, than with hempen slings; and used only two fathom of chain, which cost but eleven shillings. The ship is expected in the Thames in a week or two. The same captain also used chain hawsers in the West Indies, several years ago, and speaks much in favour of them. Many more instances might be mentioned of the good effect of the use

of chains, and of their having been used before for these purposes; with which perhaps Mr. Slater was not acquainted.

We are not acquainted with any instance of chains having been actually used for standing rigging, though it had been proposed by the captain above mentioned, previous to the year 1804.

On Mr. CLAYFIELD'*s Patent for separating Soda and Potash from their Sulphates and Sulphurets. Dated Nov.* 1804.—*Rep. Arts.*

IN Mr. Clayfield's process, the sulphate of soda, or soaper's black ash, is reduced first to a sulphuret by heating it in contact with charcoal in a red heat till it fuses, and by frequently stirring the mass in the usual manner: after this, more charcoal is added, to form the whole into a paste; and then either lead, litharge, or oxyd of lead, is added; which forms an artificial galena with the sulphur, and leaves the alkalis united to carbonic acid. A low red heat, frequent stirring, addition of charcoal, and intimate mixture with the lead, are essentially necessary to the success of the operation.

The mass, after this is broken up, exposed to the open air for a week or ten days, and then the alkalis and other salts separated by lixiviation, which will leave the sulphuret of lead behind. The neutral salts may be separated by crystallisation, and the alkalis obtained by boiling down the solution.

Two parts the weight of charcoal to three of sulphate, and five parts lead to four of sulphate, are the proper proportions required to effect the decomposition. Black ash requires less.

Observations.—A similar operation to the above, contrived by M. Dize, has been published last year in Van Mons's Journal. It effects by the agency of oxyd of lead, and other metallic substances, in the wet way, what Mr. Clayfield's performs in the dry way.

In this method, after the sulphate is reduced to a sulphuret by the process used at St. Denis, (which is done by the agency of charcoal and carbonate of lime, in a manner somewhat similar to that above described for the same purpose,) the mass is lixiviated, and to the lixivium, while in a state of ebullition, well pulverised semi-vitreous oxyd of lead is added in sufficient quantity. This oxyd separates the sulphur from the alkali, and forms with it insoluble sulphuret of lead: the oxyd changes from a red to a deep chesnut colour; and the lixivium becomes clear as pure water, and will then precipitate the nitrate of lead white, and the sulphate of copper a beautiful green, which before it threw down of a dark chesnut colour, in the state of sulphuret.

M. Dize found also that the oxyd of manganese had the same property, of purifying alkaline sulphurets, as the oxyd of lead; which, besides being less costly, has the valuable property of serving several times for the same operation, after it has been freed from the sulphur by calcination. M. Dize also asserts, that oxyd of manganese decomposes sulphuret of barytes by a similar process, and gives the barytes a considerable degree of causticity, removing the sulphur from it, and forming with it sulphuret of manganese.

The soda and barytes prepared by this process are very pure, and come to a very moderate expense.

If what M. Dize states is correct, this property of manganese adds one to the several valuable uses already discovered for this mineral.

Whether the process by the wet, or that by the dry way is the best, demands experiment to ascertain. Each may have advantages for particular purposes, no doubt; but Mr. Clayfield's at least may be relied on, which is not always the case with processes that come to us through the medium of French publications.

Account of, and Observations on, Specifications of Patents published in the Repertory of Arts and Manufactures in 1805.

Besides the two patents last recited, the specification of fifteen others have been published in the Repertory of Arts, in the four first months of this year. Of these, Mr. Porthouse's, of an engine for hackling flax and hemp, and at the same time carding tow, dated October 6, 1804, and Mr. Brown's, of a machine for manufacturing lace net-work, obtained May, 1804, cannot be accurately described, without the expensive plates given in the above work; to which we must therefore refer those who desire to see the specifications correctly copied. Indeed, any detail of them without the assistance of plates, would be very little interesting; of Mr. Brown's, for instance, little more would be known from such a description, but that the engine consisted of certain additions to that species of stocking-frame, called the Vandyke or warp-frame, wherein there is a thread to each working needle, which causes a warp similar to that in a common loom.

Mr. Noon*'s Patent for a Thrashing-Machine. Dated October,* 1804.

This resembles that most generally in use, in every particular, except that the rubbers, or parts that strike the grain from the

straw, are attached to the cylindrical frame (which brings them round successively into action) by a sort of hinges, instead of being fixed to it firmly, as in the usual way. This, Mr. Noon asserts, makes the engine work with less friction, and consequently do more work with less power, and cause less injury to the straw; and therefore if it will separate the grain as effectually as other engines, it will of course be preferable to them. A contrivance is added for preventing any damage to the machinery from the horse which moves it, going back; this, though a useful addition to horse-mills, is entirely on the same principle as that in the common roasting-jack, which admits the jack being wound up, without giving a reverse motion to its wheels and pinions.

Mr. Wolfe's Patent for Improvements in the Construction of Steam-Engines. Dated Jan. 1805.—*Rep. Arts.*

Mr. Wolfe's Specification gives an interesting account of facts relative to this important machine. He asserts his having ascertained, by experiment, that for every pound the expansive force of steam adds to the pressure on a resisting square inch, that it can expand itself to so many times its volume, and still equal atmospheric pressure. Mr. Wolfe has given a table of temperature necessary to produce certain degrees of pressure, and of steam. The pressure begins at five pounds to the inch, and that of condensation at five times the contraction necessary for equality to the force of the atmosphere; and both continue from that to 40 degrees increase; for every degree of which increase the temperature rises about $1\frac{5}{7}$ degree: beginning at $227\frac{1}{2}$ degrees of heat for five pounds pressure, and ending at 282 for forty pounds pressure to the square inch.

Mr. Wolfe has two methods of applying these facts to use. In the one, a smaller cylinder and piston is added to the large cylinder, which serves as a measure of steam for it; if the pressure of the steam be ten pounds to the inch, the small cylinder should be but one tenth the size of the large one, and so on in proportion. And the steam passing through the small cylinder is contrived to be conveyed to the large cylinder in portions equal to the capacity of the former, which afterwards expands itself in the latter so many times its former volume as the one exceeds the other in size.

The other method consists in closing and gradually opening the passage of the steam-pipe, so as at first to perform, what Mr. Wolfe calls "*wire-drawing the steam*," and not to admit the whole quantity of steam intended, before the piston had performed a considerable part of its stroke.

As in both these methods it is necessary that the temperature of the steam should not be diminished, Mr. Wolfe proposes to prevent this by making fires under the cylinders, the steam-cases of which should then have safety-valves.

Observations.—If any advantage can be obtained by thus measuring the steam, and the latter method can effect it as well as the former, it is preferable; because it avoids any increase to the parts of an apparatus, which are already necessarily extremely numerous, and which it is desirable to simplify rather than render more complicated.

A similar operation to this last was long since adopted by Mr. Watt, in his engines (though perhaps not with the same design), in which the admission of the steam was stopped before the piston had made its full stroke, and the piston afterwards impelled by a diminishing impetus, similar to that caused by a recoiling spring, from the expansion of the portion of steam included in the cylinder. Mr. Watt has contrived an ingenious diagram, to illustrate the increase of power gained by managing the engine in this manner; which, with his accurate calculations on the subject, may be seen in the *Encyclopædia Britannica.*

Mr. BATE's *Patent for a Machine to pump Water, and other Purposes. Dated Nov.* 1791: *will expire Nov.* 1805.—*Rep. Arts.*

THIS is a union of inventions long before its date, and consists of a complicated method of causing a circular motion from an alternating rectilinear (or up and down) movement, by quadrants acting on multiplying wheels, and these again on other quadrants, which give motion to a fly-wheel, by the old contrivance of ratchet-wheels with spring catches, acting at opposite sides of their circumference; which fly-wheel is to put in motion one of the oldest apparatus in existence, for raising water, practised in the East from time immemorial—a chain of water-pots or vessels circulating round a vertical wheel. This method is used in the famous well at Grand Cairo, where, by a succession of earthen pots attached to straw ropes, passed over a large wooden wheel, turned round by oxen, water is drawn up from a vast depth; and similar machines have been frequently used in this kingdom, notwithstanding which, another patent was taken out for this contrivance a few years ago.

Mr. FRITH's *Patent for dying Cotton Wool, Yarn, and Cloth, of a Nankeen Colour. Dated Oct.* 1804.—*Rep. Arts.*

MR. FRITH directs, that a decoction of galls, alder-bark, oak-bark, elm-bark, sumach, madder, and mahogany-bark, *or any one, two, or more of them,* may be used for this purpose, with a solution of iron in sulphuric, nitric, muriatic, and acetous acids, or any one or more of them.

The substance to be died is first to be washed in hot water, then dipped into the decoction of the barks, then passed through the solution of iron, and again washed in the warm water; after this it is to be passed through a solution of soap in water; then through a solution of any of the alkalis, mild or *caustic*, or through lime-water; then, while wet, it is to be dipped in a solution of tin in the muriatic, or nitro-muriatic acids, washed again in warm water, and dried.

Observations.—In this process, Mr. Frith does not state the *proportions* of any one of the ingredients used, on which the colour must depend as much as any thing, and which seems the more necessary, when certain of them are known to strike a black colour, if used in a particular manner. If a decoction of elm-bark (which is of a mucilaginous nature, and differs in other respects from oak-bark), or one of madder, which usually gives a red colour, will produce the same effect as oak-bark, with *any* of the solutions of iron, it is an extraordinary fact.

Another singular phænomenon in this process is, that in it goods of all descriptions, not excepting woollen or silk goods, may be passed through a solution of *caustic* alkali of unlimited strength without injury.

But even this is not so wonderful as that, with such vague and apparently inaccurate directions, any dyer can produce a colour reckoned so difficult to dye, as that of the Nankeen tint.

Mr. MARTIN'*s Patent for making Pig and Cast-Iron from the Ore, or melting Cast-Iron, by Coal or Culm. Dated June,* 1804.

FOR this purpose Mr. Martin directs, that the furnace should receive its charge of coal and stone ore, or cast-iron, by degrees, as the fire rises, till the whole is full of vivid fire, before the blast is introduced; then to introduce the blast very gradually for the first twelve hours, and afterwards to increase it by degrees, from day to day, for the first week, till the furnace is sufficiently hot; and then to blow to any extent the machinery or the furnace is capable of bearing, still feeding the latter with proper materials.

Observations.—If, by this method, coal or culm can be made to have the effect of coak, in preparing iron from the ore, it is a most valuable discovery; but how far this takes place, can be only known by inspecting works managed in this manner.

Mr. CAMERON'*s Patent for Improvements in Sawing Machines, and new Methods of working them. Dated Sept.* 1784.

THIS patent expired in 1798; and, as we are unable to discover any improvement in sawing machines, or to perceive any material

difference in this machine from the engines in use elsewhere for the same purpose, long before the date of this patent, and of which accounts may be seen in most publications relative to mill machinery, and even in the *Encyclopædia Britannica*, we think any description of it needless.

Mr. Saxelbye's *Patent for making White Lead without the use of Horse-Litter or Tan. Dated May*, 1804.

This method consists in causing the heat proper for the work by fuel, in stoves or receptacles for the pots containing the lead and acid, regulated by dampers and registers according to a graduated thermometer, instead of using horse-dung or tan for the same purpose; and also in using the heat of steam for the same purpose. To prevent excess of heat, a valve is contrived to open on an increase of temperature, and close on a diminution of it, by being connected with the arm of a pyrometrical apparatus, or with a float supported by the "mercury of a large thermometer."

Observations.—This is a very desirable improvement in the manufacture of white lead; and, therefore, it is to be regretted that the patentee has not described the apparatus by which it is effected in any terms which convey more information on the subject, than what is contained in the above account.

Mr. Greaves's *Patent for Improvements on Razors. Dated Aug.* 1804.

The addition to common razors, prepared by the patentee, consists of two methods of keeping the blade open at any required angle to the handle, by springs and catches, something similar to those sometimes used for large clasp-knives: but whether this is an improvement, depends on the fancy of shavers, some of whom think it a conveniency to be able to alter the inclination of the blade to the handle at pleasure, by the motion of a finger, without stopping the operation.

Mr. Steers's *Patent for an Hydraulic Pressure-Engine. Dated Dec.* 1804.

In this engine, the pressure of water, caused by an elevated pipe, is made to press on a piston fitting closely in a cylinder, which gives that power, now well understood, but formerly called the hydraulic paradox, which Mr. Bramah has applied in his hy-

draulic press. This pipe is formed with a joint to the cylinder, which permits it to be moved from a perpendicular to an horizontal position; by the alternating of which motion, the patentee imagines so great a power will be gained, that it will not only work itself (or in other words be a perpetual motion), but have a vast surplus of force, which may be applied to work pumps, turn mills, &c. The moveable pipe is balanced by a counterpoise, to make it more easy to raise.

A variety of ways are detailed for causing the various motions above mentioned, which are all well known to those acquainted with hydraulic engines.

Observations.—The working piston pressure-engines by an elevated pipe, is a very old invention: one on this principle was erected, at Seve, near Paris, by MM. Denisard and Dueille, in 1731, which is described in Belidor's Hydraulic Architecture; and engines on the same principle have been erected in Cornwall, and elsewhere, by Mr. Trevethick, some years since. As to the power gained by elevating and depressing the pipe, the patentee deceives himself, because the sum of the force and time requisite for raising the pipe, and water for working the engine, is demonstrably equal to the pressure of the piston, and therefore can only form an equilibrium with it.

The engine will make a very good hydraulic press, though it will by no means answer for pumping water, or working machinery; and, if the patentee does not interfere with Mr. Bramah, who has a patent for an hydraulic press, on a somewhat similar principle, he may probably make something by it for this use. For some purposes it will be better than those presses of Mr. Bramah, in which forcing-pumps are used, particularly where a long-continued pressure of the same intensity on a yielding body is required.

Mr. Underdown's *Patent for making Flour without Grain. Dated Dec.* 1804.

Mr. Underdown declares he has invented the art of extracting the fecula from potatoes, parsnips, white beets, turnips, and Jerusalem artichokes; his method for doing which, is the same ever used for this purpose,—that of grating or grinding the substances, mixing the pulp with water, and letting it stand several hours, straining off the water, adding fresh water, and repeating the process till the water runs off clear. After this, it is to be pressed and dried in a kiln, and then ground in a corn-mill "till it becomes flour."

Observations.—That Mr. Underdown invented this process, is not material to dispute; but certainly he was not the first who in-

vented it: there is scarcely an elementary chemical book published, which does not contain this process for obtaining the white fecula from many other vegetable substances, besides those mentioned. The fecula obtained from potatoes, has been repeatedly noticed in various periodical works of late years; and another kind, obtained from horse-chesnuts, has been much commended for certain purposes.

But Mr. Underdown professes to make flour of this fecula, which no one else does: the most which the best chemists have ventured on this point is, that white fecula ground might, when mixed with wheat-flour, make bread. If Mr. Underdown has made this discovery, he still keeps it to himself; for the process mentioned in his specification, would only make hair-powder, not flour.

Any baker could inform Mr. Underdown, there was an essential difference between the two articles; that his ground fecula would therefore never rise with barm, would never make bread, and, consequently, could not be flour; and chemists have disovered the reason of this, which is, that it wants the vegetable gluten which flour contains.

Mr. Underdown, indeed, mentions, that the fecula should be ground "till it becomes flour," which some might imagine implied a power in the grinding to effect this purpose: but this process had better not be too much relied on, though it is the only one mentioned by Mr. Underdown for making flour of fecula.

How far the starch-makers will be satisfied that Mr. Underdown should monopolise the use of so many articles which properly belong to their trade, and which has been known to all Europe long before this patent was obtained, is for them to decide.

Mr. WARRIS*'s Patent for an Improvement in the mounting of Opera-Glasses. Dated Aug.* 1804.

THIS improvement consists of a depressed circular cavity, or groove, on the internal part of the rim of each of the sliding tubes of the opera-glass, which groove admits within it the projecting part of the next adjoining tube; by which means, the whole can be closed with a level surface, so as to occupy no more room in the pocket than a flat snuff-box.

Mr. RAINE*'s Patent for making Hard Glue from the Tail, Fins, and other Parts of the Whale. Dated Nov.* 1804.

THE object of this patent is explained in the title. The parts of the whale, mentioned in it, are directed to be kept in

boiling water, on a slow fire, for half an hour, to extract the oil and grease: then they are to be steeped four times for 48 hours, in fresh water each time: then, to each ton of materials is to be put 120 gallons of fresh water, and the whole to be boiled in common glue-bags for twelve hours: then, the fire is to be put out, the bags removed, and what has strained through the bags is to remain in the copper half an hour; after which, 20 pounds of alum is to be added for each ton of the original materials, mixed well, and left twelve hours more to incorporate: then the gelatinous fluid is to be let off into coolers, and when cool, cut, and dried in nets in the manner usual for other glue.

In two other papers on glue, in this Number, will be found observations on this subject, to which we refer.

Mr. Ryan's *Patent for an Apparatus for boring all kinds of Soils. Dated Feb.* 1804.

Mr. Ryan's invention consists, principally, in cutting the ground into cores or cylinders, by instruments contrived for this purpose (instead of scooping out the cavity wanted, as usual), and afterwards, extracting those cores by other implements. The first instruments are of the nature of cylindrical saws, which cut round the surface of the core, and the others consist of tongs, with semi-cylindrical lips, and of other forms proper for extracting the cores: a different species of cutting instrument is adopted for each kind of soil, from that of the softness of mud to the hardness of rock; and the whole altogether forms a complete apparatus for the work it is intended for in every situation; which is described fairly and distinctly in that manner which fully answers the condition of the patent, and best secures the invention: therein forming a contrast to other specifications, where such a leaning is often exhibited to conceal the invention, by obscurity or inaccuracy of description, as tends to endanger the patent, and sometimes altogether renders it null and void. It cannot be too much impressed on the minds of those who would obtain patents, that it is not sufficient for them to relate, in their specifications, merely the thing to be done, but that they must fully explain *how* it is to be done, *so as that others can do the same.*

On Means of assisting Persons in danger of Drowning.

By Mr. H. Lawson.—*Phil. Mag.*

The absolute necessity that assistance to persons in danger of drowning should be speedy to be effectual, induced Mr. Lawson to consider what articles were most readily and universally to be found at hand in all cases, which could be converted into a floating apparatus, either for the use of the person in danger, or of those who might venture to his assistance. What seemed to Mr. Lawson, in a great measure to answer all those conditions, is the buoyancy afforded by a common hat reversed on the water, which will thus admit of being loaded nearly with ten pounds weight before it will sink, and will bear seven pounds with safety; and as the body of a man is about the same weight as the water, a buoyancy equal to seven pounds will effectually prevent his sinking. To render the hat more manageable for this purpose, and less liable to fill with water from accidents, Mr. Lawson recommends, that it should be covered with a pocket-handkerchief laid over its aperture, and tied firmly on the crown: Mr. Lawson asserts that with a single hat prepared in this manner, held by the tied part, a man who even does not know how to swim might venture safely to assist one in danger.

When two hats can be had, Mr. Lawson recommends that a stick be run through the tied parts of the handkerchiefs which cover them: and if more hats could be got, it would be still better; four hats may thus be fastened to a common walking-stick, which will thus sustain at least 28 pounds.

When a stick is not at hand, another pocket-handkerchief tied to the lower parts of those which covered two hats, would thus unite them like a pair of swimming corks, and make them equally convenient.

If a man happens to fall out of a ship or boat, he may support himself till he can get assistance, by turning his hat on its crown, and holding by its brim with both hands, so as to keep the hat level on the water.

Mr. Lawson recommends that the Humane Society should have at their receiving-houses large foot-balls, furnished each with a string and small weight, to throw out to those in danger, (if the expense of swimming spencers for the same purpose should be thought too great) by which they might support themselves till better assistance could be procured.

Observations.—The number of accidents that happen every year both to swimmers and skaiters (the more melancholy, as the sufferers are generally in full health and vigour, and often in

the midst of gaiety and frolic), make Mr. Lawson's contrivances, for affording instant relief in all cases, very valuable; and should therefore obtain them notice in every publication where they can be admitted.

The large foot-balls which Mr. Lawson recommends for assisting persons in danger, might be rendered more serviceable by uniting them in pairs like swimming-corks; and would be thus nearly equal to swimming spencers; which latter differ somewhat from a cork jacket, and consist of a cork girdle, which is made by stringing a number of old bottle-corks (which may be procured at a small expense) on pack-thread, and uniting as many of those strings of corks as will form a belt of six inches diameter, which is enclosod in oil-cloth, and furnished with bands for girding it over the shoulders and between the legs.

It is strongly recommended, in the *Esprit des Journaux*, to carry a number of those cork spencers in every ship for the use of the seamen; and an instance is mentioned in it where the lives of hundreds might have been saved by some such contrivance, in the fate of an English vessel of war which was burned within view of the shore, off Leghorn.

If those spencers would take up too much room aboard, another kind might be made, which would not have that objection, of canvas or oil-cloth cases, of the same size as the spencers, stuffed with bladders not quite blown full: every seaman might keep one of these in his own chest, which, when void of air, would not take up more room than a pair of stockings, and when wanted might be blown up in two minutes. Those commanders of ships who would not think it worth while to attend to these minute matters for the sake of the sailors, may perhaps do so for the sake of the ship. The inaction and insubordination which total despair produces among the crew has often caused the loss of valuable ships; and such a contrivance as this mentioned, though it might only keep those who used it afloat for a few hours, would prevent this despair, and make them stick to the ship to the last. In case of a ship taking fire, which often happens near other ships or the shore, their use would be indisputable.

In addition to the methods before mentioned for giving assistance in case of accidents, the following means of preventing their frequency, in the neighbourhood of this and other large cities, is earnestly recommended to the attention of the Humane Society, and other benevolent gentlemen; which would not only have this effect, but greatly contribute also to the health, cleanliness and activity of that valuable class of men, to whose labours the rest are indebted for most of the necessaries and comforts of life.

All those advantages would arise from having large ponds prepared near the city, of about four feet deep, well supplied with

fresh water, in which any one might be permitted to bathe or swim, for a penny paid at the entrance; within some feet of the bank, these ponds should be surrounded with walls or hedges, and might be planted, in the interval between these and the water, with shrubs, so as to form an agreeable walk all round. There is no doubt but ground might be procured in Hyde-Park for this purpose, if properly applied for. The excavation to so small a depth would cost very little comparatively, and the trifle paid at the entrance would assist in paying interest for this cost. Baths for the use of the lower classes of people, furnished at the expense of the benevolent and rich, are universal in most parts of Asia, in Russia, and in several other countries. That there are none yet in England, unless some few for the actual sick, can only proceed from no one having suggested their use to the public.

As a farther inducement to gentlemen to subscribe to form such swimming places, it should be considered, that they will form excellent situations in winter for skaiting, where this fashionable and manly amusement may be practised *in perfect safety*, which will be an argument in their favour, even to those gentlemen who do not skait themselves, as there are very few of those who have not some friends or relations who use this exercise.

For both swimming and skaiting, the ponds should be made of considerable extent: if formed on a too confined scale, the cost would be thrown away, as in this case few or none would frequent them; and it is evident, that to make them serviceable in preventing accidents, they should be formed as much as possible, so as to induce people to prefer them to any other situations for the above purposes.

It need scarcely be mentioned, that the circumstances which would constitute the safety of those ponds for the above uses, would be their small depth.

A Method of preserving Hops for Brewing Malt Liquor.

The author proposes to distil the hops with water, and separate the essential oil which will be found floating on the surface of the water: what remains in the alembic is to be well pressed, and evaporated to the consistence of an extract in adding to it the distilled water: when wanted for use, the essential oil should be mixed with a little sugar, and then diluted along with the extract by the wort. The beer thus produced is more bitter than usual, whence the author concludes that it will either keep longer, or that the hops will effect more by this management, though used in smaller quantity. In scarce years he proposes to substitute for hops the *menyanthis trifoliata*, with the addition of a third or fourth of good hops.

Observations.—Brewers alone can judge how far the expense of this process would be paid; by the extract of essential oil keeping better than the raw hops. The question greatly depends on the degree of injury to which hops are liable in the present method of storing them.

It has been much recommended, by persons who have tried it, to use an infusion of hops, made in a separate vessel, instead of putting the hops directly into the wort, as giving the beer a much superior flavour: this is at least worth a trial, as the expense would be little or nothing additional, there being scarcely any doubt but that it would preserve the beer equally well in this manner. If this method be found to give a more agreeable taste to the beer, it will afford an additional reason for the use of the extract, which probably would be attended with the same effect.

The principal use of preparing hops in the manner described seems, however, to consist in the great facility it would cause in the article of carriage: for the extract and essential oil would take up much less room, and have so much less weight than the raw hops, that they would come cheaper to the distant consumer and thereby extend the market for the planter.

Extraction of Spirituous Liquor from Potatoes.—Ann. de Chim.

For a long time it has been customary in Germany to use potatoes in the manufacture of spirituous liquor, on account of their cheapness, the good quality of the spirit produced, and their affording, in the residue, a most nourishing aliment for cattle: this practice is also spreading into Prussia and Lithuania.

To obtain this spirit, it is necessary to mix a certain quantity of malt with the potatoes, of which the best relative proportions are not probably yet ascertained, as the direction is to use either about a twelfth or a sixth part of malt to one part of the potatoes (120 parts of potatoes to 10 of malt, or 110 of potatoes to 17½ of malt).

The potatoes are first prepared by steam in a large cask to which a pipe passes from a closed boiler; a small door is contrived in the top of this cask, so as to be shut steam-tight, and another near the bottom in one side, the one to put in the potatoes, the other to take them out of the cask. When the potatoes are sufficiently done, they are then bruised to a fine pulp in a kind of mill, which consists of two horizontal rollers, either of hard wood or stone, placed close together, surmounted by a sort of hopper, for containing the potatoes, and submitting them to the action of the rollers; a transverse piece of wood fixed beneath each roller detaches the pulp from them, which falls into a vat, whence it can be taken for use.

When the potatoes are nearly cooked, the malt is made ready by pouring hot water on it in sufficient quantity to make the whole very liquid: the potatoes are then added as they are bruised: the mixture is then well worked up till no lumps remain, and the whole is reduced to a uniform consistence; then it is left to cool, care being taken to stir it up from time to time; after this the ferment is added: some for this purpose use common beer barm, others a sort of leven, prepared from rye-meal, by diluting it with boiling-water to the consistence of thick soup, and adding to this, for the first time, a little beer barm. It is particularly necessary to be careful in adding the boiling-water; for if it be too hot, it is liable to spoil the operation.

It should be observed that the potatoes ferment with great facility, and require but little yeast. Oftentimes the fermentation is very violent, and the liquor is covered wih foam, and yet it lasts for a considerable time: at other times the more thick parts form a crust at the top of the liquor, through which no froth can pass, but under which the fermentation proceeds very briskly.

It is found that the addition of beet-roots or carrots to the former mixture, produces a spirit of a better taste and in greater quantity. It is observed here, that it seems from this that the capability of the vinous fermentation does not always depend on the quantity of sugar which matters contain; for potatoes contain only a fecula, and, it is seen, that grain produces spirit in proportion to the fecula, and perhaps to the gluten it contains.

Observations.—Every means by which potatoes can be substituted for barley, must contribute, in some degree, to make bread more plentiful; for oftentimes the same ground, which is now allotted to barley, would produce wheat, and if it were found that potatoes could serve so well to diminish the quantity of malt used in distillation, of course there would be less barley and more wheat produced. It would also be of advantage to the farmer to have a greater demand for the produce of an ameliorating crop, as potatoes are always considered, as his land would be thus less exhausted.

It appears that the observation inserted (relative to sugar not being so necessary for vinous fermentation as was supposed), is not very exact; for beet-roots and carrots, which abound in the saccharine principle, were found to increase the quantity of spirit produced; and from the necessity of mixing malt with the potatoes, it seems probable they would produce no spirit without the addition of some matter of a saccharine quality: what the best proportion may be of the sugar to the starch, and other matters contained in the mixture, to produce most spirit, seems a desirable fact to ascertain, but not yet determined.

To make New Brandy have all the Qualities of that of the oldest Date.

Bib. Phys. Econ.

THIS method consists of pouring five or six drops of volatile alkali into each bottle of brandy, and shaking it well, which removes the acid on which the taste and other qualities of the new liquid depend.

Observations.—This experiment is so easily tried, that it deserves notice, even though its success should be doubtful. The discovery is very valuable, if it will make the new liquor as wholesome as the old. There is no reason why it should not succeed with other spirituous liquors as well as brandy.

Easy Method of purifying Water.—Bib. Phys. Econ.

A MEMBER of the Society of Sciences and Belles-Lettres at Douay has published this method, which consists in forming a filter, by placing in an empty flower-pot a wicker frame horizontally, over which four or five inches thick of pounded charcoal are to be laid, and on that a bed of sand, and over all a paper pierced with holes to prevent the water, on being poured in, from forming pits in the sand. The filter is to be renewed at the end of some time. This simple and cheap method will enable even the poorest man to procure pure and wholesome water, which is a circumstance of great consequence in many foreign countries, and even in some parts of England.

Farther Success of Fumigations by the oxygenated Muriatic Acid.

Bib. Phys. Econ.

ACCOUNTS are published in the above periodical work, of intelligence from Spain, that in the midst of the dreadful contagion which reigned in that country, the inhabitants of those houses where fumigations of oxygenated muriatic acid were used, had no attacks of the sickness, and enjoyed the best health.

This is a fact which deserves the most extended publicity at a time when Europe is menaced with this terrible epidemic.

Black Ink in Tablets.—Bib. Phys. Econ.

LAMP-BLACK, free from any mixture of charcoal in powder, is to be diluted with clear water in a new glazed pot, and to this is to be added a little good potash or salt of tartar; these are to be well boiled together: the mixture is afterwards to be well washed with water, and passed through a silk sieve, rejecting that part which remains on the sieve. It is then to be left to settle, the water to be drawn off, and the sediment dried. This black sediment, when dry, is to be ground with gum-water, on a marble slab, with a muller of the same material, divided into squares, and dried in the shade for use. This, the author asserts, serves as well as Indian ink, both for drawing and for the use of copper-plate printers.

Observations.—The operation of the potash has probably more effect, than the author of the work from whence this extract was made, seems aware: he attributes to the potash merely the effect of freeing the black from any oily matter it may have retained; but, from the effect of alkaline preparations in another method of making a good imitation of Indian ink, which has been published in the Repertory of Arts, it is most probable the action of the potash is the principal cause of the lamp-black mixing so well with the other materials. The other method alluded to, shall be described in the next Number of this Work.

To make Wax soluble in Water.

J. CHR. WERNER, of Neustadt (in Germany), has found the following process very effectual. For each pound of white wax, he takes twenty-four ounces of potash, which he dissolves in two pints of water, warming it gently. In this lie he boils the wax cut into little bits for half an hour; at the end of this time he takes it from the fire and lets it cool. The wax fixes itself at the surface of the liquor, in the form of a white saponaceous matter, which being triturated with water, produces what is called wax-milk or encaustic wax; and which may be applied to pictures, furniture, or leather, after having well cleaned them; in an hour after the application, the article should be rubbed with a piece of woollen cloth, which will cause the pictures to have a better effect, and the furniture to acquire a peculiar brightness. Another advantage of this preparation of wax is, that it can be mixed with all kinds of colours, and consequently be applied in a single operation.

Observations.—It has long been much desired by the artists

who use water-colours, to find some substance to mix with them, which would defend them from the destructive operation of the air, without producing that gloss which varnish occasions. It seems probable that some preparation of wax, on the same principle as the above, might have the desired effect, as the wax has no gloss unless rubbed or polished with an intention to produce it.

A Method of Engraving without tracing the Outlines of the Design.

Bib. Phys. Econ.

M. Rosospina, an expert engraver at Boulogne, has discovered a method of transferring a design to the copper-plate, without tracing it with the point.

He sketches the design as usual, on a sheet of transparent paper, but uses for this purpose an ink made of blood-stone, pounded fine, and diluted with a solution of sugar; he put this in a vessel with some cotton, whence he takes it as he wants it, with either his pen or the other instruments proper to lay it over the lines of the design.

When the design is completed, he spreads it on the surface of water, with the right side of the leaf in contact with the water.

A few instants are sufficient to melt the sugar contained in the ink: he then carefully places the design on a copper-plate lightly varnished, and, after covering it with card-paper, passes the whole under a copper-plate rolling-press. The red lines are then completely transferred to the copper; and to fix them it is only necessary to give the plate a small degree of heat, which renders the colour so adherent that the varnish must be taken off before the lines of the design can be made to disappear.

Apparatus for cooling Wine, &c.—Bib. Phys. Econ.

M. Bellanger, a French architect, has contrived the following apparatus for cooling wine or other liquor. He got a cask hooped with iron, such as is used for oil; the head was removed, and a hole made in the bottom fitted with a cork; a smaller vessel in the shape of a churn was placed inside this, supported a little distance from the bottom by two pieces of wood. The intervals between the two vessels were then filled up with charcoal-dust, and a cover prepared for the inner vessel, in whose inside several hooks were fixed: over this cover was placed a sack of charcoal-dust two feet high.

This apparatus was buried almost two-thirds in the earth at the bottom of a cool vault. The inner vessel was almost filled with ice or snow, which was perfectly well preserved in it: a pipe with a cock was so fixed at the bottom as to let off any water which ran from the ice.

When wine or other liquors were to be cooled, the bag and cover were lifted off: the bottles containing the liquors were suspended to the hooks, and the whole carefully closed again.

Half an hour was sufficient to freeze the surface of the liquor in the bottles.

Wet earth is said to be unfit to place this apparatus in.

Aerostatic Experiments.—Ann. de Chim.

In the last Numbers of the Annales de Chimie, circumstantial accounts have arrived of two ascents made in air-balloons, for the purpose of experiment; one by M. Gay-Lussac in Fructidor, an. 12, (1803) from Paris, the other by Messrs. Robertson and Saccharoff, from Petersburgh, in June 1804.

In both ascents all the various instruments for ascertaining the gravity, temperature, moisture, and electricity of the atmosphere, at great elevations, were provided; and also vessels properly prepared for enclosing a portion of it unmixed, for the purpose of chemical analysis; and in both cases these vessels were deprived of air before the ascent, by mercurial exhaustion. Dipping-needles, compasses, and accurate watches, were also carried up.

Gay-Lussac seems to have been much embarrassed, by several of his instruments getting out of order; he lost part of his electrical apparatus, which rendered the rest useless, and the frame of his dipping-needle got so much *warped* by the drought occasioned by the rarefied air, as to bend the graduated circle, which must have been caused by some part of it being needlessly made of wood, bone, or horn. No experiments were made on either instruments, and we must look to the result of some future ascent for ascertaining what may be determined by them.

The temperature at the earth was 27,75 of the centrigrade thermometer, and at the greatest ascent 9,5; whence M. Gay-Lussac concludes that an elevation of 173,3 metres (567,557 feet) will correspond to each degree of the reduction of temperature.

The greatest elevation of the balloon, calculated by the depression of the barometer, was 6977,37 metres (22850,887 English feet) above Paris, or 7016 metres (22977,4 feet) above the sea.

From the observations on the hygrometer, it appeared that

the quantity of water dissolved in the air at different elevations, follows an extremely decreasing progression.

What magnetical observations he could make with such instruments as he had in order, gave him reason to conclude that the magnetic power does not, at the greatest elevations, experience sensible variations. The needle was also attracted by one extremity of a small key, and repelled by the other at the height of 3803 metres (12651,325 feet) in the same manner as on the earth.

The air-vessels were filled, one at the height of 65,61 metres (21487,275 feet), and another at that of 6636 metres (21733,9 feet); the air entered both with a hissing noise. On emptying them, after his descent, under water, the water filled at least half their capacity, which proved that they had retained their vacuum very well, and that no foreign air had entered. On analysis the air was found precisely of the same component parts at the highest elevation and on the earth. He observes, that this agrees with the results of the experiments made by Saussure, jun. on the lofty mountain Col-du-Grant, and on Mont Blanc by his father; whence it may be concluded, that the constitution of the atmosphere is the same at all elevations.

At his greatest elevation he observed clouds above him at a considerable height: he also observed another circumstance, which is not easily accounted for; though moving in the current of the atmosphere, he perceived *a wind*, which, though slight, was sufficient so to derange the compass, (from which he had removed the glass to prevent its being obscured by moisture) that he was soon obliged to give over making experiments with it. It is to be regretted that he did not insert the direction of this wind, for a reason that will be mentioned farther on.

The account of the Russian ascent does not contain so much scientific observation as the French; but there are many particulars in it worthy of notice; and some, though of no great consequence, yet somewhat interesting. The gentlemen who ascended seem to have provided for a long voyage, by the quantity of provisions which they carried with them; though, by the late hour of seven o'clock in the evening, on which they departed, (which limited their aërial journey to a small extent) this precaution did not appear very necessary. Besides a complete set of similar instruments to those already described in the French ascent, they took with them a large telescope, a speaking-trumpet, and a small instrument, to be described hereafter, which is denominated, in the account, a *float*. They also carried with them fire-arms, live pigeons, together with some chemical acids and quick-lime, of which last articles it does not appear they made any use.

Their greatest ascent was to an elevation indicated by the mercury sinking to twenty-two inches in the barometer, at which time the thermometer pointed to 4½ degrees; at this elevation

they observed the situation of the compass, and found a result very different from that of M. Gay-Lussac, for the needle, which was horizontal at the earth, had departed from this position; the north pole of it was elevated ten degrees, and the south pole of course depressed towards the earth.

At different heights they gave liberty to their birds, who seemed not very willing to accept it; the poor animals were so terrified with their situation, that they clung to the boat till forced from it; when it appears their fears were not groundless, for, on account of the great rarity of the air, their wings were nearly useless, and they fell towards the earth with great rapidity; the second struggled with eagerness to regain the balloon, in vain; and the third, thrown out at the greatest elevation, fell towards the earth like a stone, so that they supposed he did not reach the earth alive.

They carried with them a little instrument, (constructed of two sheets of thin paper, placed so by a light frame that their planes crossed in the middle at right angles,) which was suspended ten fathoms below the balloon. This, it appears from the account, always kept behind the balloon, in a line contrary to its progress, so that by it and the compass they knew their course; which it seems is no easy matter to do, as, at a great elevation, the balloon, though moving forward with great rapidity, appears quite stationary, from the absence of visible objects to compare its motion with. What objects they can discern beneath, appear also all equally near, from the space visible being so much contracted in extent, by the distance of the observer, that there is no judging of it by the eye. This last they obviated, by fixing a telescope through the bottom of the boat of the balloon, adjusted perpendicularly by a plummet, through which they discerned the objects over which they directly passed, so as to perceive their progress very perfectly.

At their greatest elevation they filled their air-vessels, and brought the air safely down for analysis; but this analysis was not completed when the account was written.

They found the speaking trumpet of some use in their descent; the voice through it was re-echoed most perfectly from the earth, even at the greatest elevation; and the time of the return of the echo so well coincided with their height, increasing in quickness as the latter diminished, that it is proposed as a means by which aëronauts may be enabled to judge of their elevation in future. Each time they spoke through the trumpet, a slight undulation of the balloon was perceptible; and they found the return of the echo to take up ten seconds, when the barometer was at an elevation of 27 inches: from this the narrator calculates, that they were then 5190 French feet from the earth; but that, as it is probable the progress of sound perpendicularly has not the same law as its velocity in an horizontal direction, he thinks this calculation may not be very exact; and proposes to ascertain

the law of the perpendicular movement of sound by firing cannon every thirty seconds during the ascent of a balloon, and observing the instant of hearing each discharge with a stop-watch, in the balloon, which compared with the same times noted below, would in their difference furnish means to ascertain this fact. They descended at Sivoritz, 60 versters (about 20 French leagues) from Petersburgh, at fifty-five minutes after ten o'clock P.M. which gives a velocity of movement of more than seventeen feet four inches in a second, and is another proof of the quickness of the motion of the air; for, during the time of their voyage, the wind was scarcely sensible on the earth.

Observations.—The narrator of the Russian ascent has thought fit to embellish it with a very poetical preface, relative to "the obstinacy with which Nature holds down her immense veil, and with what difficulty the united efforts of chemists, astronomers, and naturalists, can raise up the smallest corner of it." We have not inserted any abstract of it, as we deem poetical flourishes as much misplaced in such narrations as in sermons, which a learned man observed were in the latter like the blue and yellow flowers in a corn-field, which, though pleasing to the eye, diminished the crop. He has also, without any hesitation, in a decisive manner accounted for two or three facts, not easily solved, in more than one instance evidently erroneously, and proposed some means of ascertaining others for which he states no reason.

The circumstance of the paper instrument following the balloon, he decides to be occasioned by its being *lighter* than the balloon, (and therefore he calls it a *float*) and obeying less the current of air from its occupying less surface. It is evident, if it were lighter than the balloon, that all paper must fly away of itself; and besides, there is no more apparent reason why a small body supported in a current of air should not move as fast as a large one, than if in a current of water. The circumstance of a wind, or counter-current of air to that in which the balloon moved, at and below the level of the boat, is however evident, from this fact, to have taken place in this instance as well as in that of the French ascent, and is a very unaccountable matter, the explanation of which, however desirable, is not so easy to solve as this gentleman thinks.

He also does not tell us *why* he conjectures, from the circumstance of the inclination observed of the magnetical needle, that "perhaps the magnetical attraction may be found to diminish as the squares of the distance from the earth, and so furnish to naturalists a new means of guiding themselves in the air, and judging of their elevation."

He moreover proposes, as a new discovery, the dissipating tempestuous clouds or rain by the discharge of cannon, from observing the oscillation of the balloon caused by the action of the speaking trumpet. This, however, is a very old proposal;

and a full account of an instance where it *is said* to have been put in practice, will be found in the life of Benevento Cellini, which shews the notion at least is no novelty.

The principal circumstances of note in the Russian ascent, are the means used to ascertain the course of the balloon by the so called *float*, and the perpendicular telescope; the dipping of the magnetic needle at a certain height, and the counter-current of air to the motion of the balloon. Those of note in the French ascent are, the similar constitution of the atmosphere, and the permanence of the intensity of magnetic power at all heights, and the wind observed to blow on the balloon when elevated. The accounts differ in respect to the dipping of the needle; but the bad state of Gay-Lussac's apparatus gives the preference to the Russian experiment in this instance, or at least leaves the matter still in doubt.

On the Mechanical Direction of Air Balloons.

The *Esprit des Journaux* contains an account of M. Pauli, a native of Swisserland, having constructed an apparatus by which he can move a balloon through the air in all directions, and advance *many leagues in an hour*, without the least wind assisting him. It mentions, that in the beginning of October, 1804, he ascended at Sceaux, and, when at an elevation of 1000 metres, made his balloon take a *semi-circular* course, and seemed to return to the point whence he set out, and then shaped his way to the right, and again turned to the left, and performed the same many times; but *unfortunately*, being alone, and having only half the force calculated, he could not go directly *against the wind*, as he intended, which blew from the south-east, but, instead of that, directed himself to the south-west, in which line he arrived at Ossinville in *less than an hour*, a distance of five leagues.

Observations.—In the above account we are favoured with many wonders, and more are hinted at; but we have not the least intimation of the means by which any of them were performed. It is not the first time that similar accounts have been spread of others as of M. Pauli, which have turned out to be void of foundation. It might seem too decisive to say it was impossible for the strength of a man to perform what M. Pauli is said to have done, when so circumstantial an account is given: but it at least is allowable to hesitate in believing it, especially as the French publications, with a few exceptions, are not remarkable for strict adherence to truth.

Though we have no direct experiment of what resistance a balloon makes to progress through the air, as it has only been

seen in the act of floating in a moving medium, at least in this country, yet it may easily be conceived in this case, by comparing it with the impulse which a sail, of similar dimensions with the area of the balloon, would receive from a wind blowing at the rate of five leagues an hour (which is probably such as would move a vessel four or five miles in the same time): from this it is plain, that as the strength of no one man could hold such a sail against this wind, so neither could the strength of one man impel the balloon at that rate.

It seems, from this view, to be totally useless ever to attempt to give motion to a balloon by the strength of the aëronaut, as the small velocity which he could give it by his greatest exertions, applied in the most favourable manner by the best-constructed apparatus, could tend to no purpose of any great utility. Some have had expectations that the steam-engine might be applied to give motion to the balloon, by some contrivance which would remove its unfitness for this office in its present ponderous form; and Dr. Darwin, in his beautiful poetry on this subject, has not hesitated to prophesy the actual completion of the design. In like manner some chemical philosophers have foretold the speedy discovery of the art of transmuting metals into gold, by which we might have it at least as common as lead; but there seems no symptom of our being yet any thing nearer either discovery; and as to the latter, since ever the prophecy was made, one would imagine, that the counter art was rather practised here, or that of transmuting gold into other matters, from the increasing scarcity of that precious metal.

The means of directing the balloon, if we attend to the facts published by those who have ascended in them, seem most likely to be found in a proper attention to the currents of air, (which, in general, are experienced to be very different at different heights), either by directly passing the balloon from one to the other, or by some light apparatus sustained at a distant elevation from the balloon, either above or below it, by which a plain surface could be made to assume different degrees of inclination to an horizontal vertical plane: the simplest means for doing this, seems to be by sending up a second balloon above the first, to which a large inclined plane should be attached, of somewhat similar construction to a school-boy's kite, with three or more cords proceeding from different parts of it to the seat of the aëronaut, by pulling more tight any one of which the inclined plane would of course assume a different position. Indeed if the fact mentioned in the two preceding ascents, be found to be uniform in others, that a different current of air from that in which the balloon moves, is experienced even so near it as the boat, a less expensive apparatus than the above might effect the same purpose, and a large light sail depended from the boat, properly extended and fixed so as to assume different degrees of inclination at pleasure, would, perhaps, be all that was necessary. It

would, in both cases, be better if another large sail, or plane, were extended permanently between the boat and balloon, which should have much more length than depth, as by the different inclinations of the two sails, a greater variety of courses might be steered. There is the greater probability of this method being of use, as we have other proofs that this difference in the currents of air very frequently takes place; for we can often see two tiers of clouds, one of which moves in a different direction from the other; and, there is reason to suppose that this is much more frequently the case than we are likely to imagine; some have advanced that it was always the case, and that when the wind blew in one direction near the earth, there was always a counter-current at a higher elevation: but, it is not absolutely necessary to the direction of a balloon, that the second current of air should move directly contrary to the first, or indeed, that it should move contrary to it at all; for it is quite sufficient if there be a different stratum of air, from that in which the balloon moves, within reach, which either has no motion, or, though it move in the same direction, has either considerably more velocity, or considerably less than the other: and when the effects are considered, which must be produced by the different density and weight of the air, and its different temperature at different elevations, in causing different degrees of motion to different strata, it is more than probable, that with very little exception, there are always strata of air situated as to their motion as above described, and that the power of loco-motion from these causes, would be at least as frequent as that on the surface of the sea from the stratum of air just above it assuming the same difference as to motion from that of the latter, as those mentioned to exist between two strata of air. It is very probable there are also different currents at different depths of the ocean more frequently than is supposed; of which fact some remarkable uses might be pointed out, but this is not the proper place to insert them; they may, however, be conjectured from what is mentioned already here.

But if artificial means should be still thought more advantageous for impelling balloons, than the method dependent on the natural variation of the currents of air, pointed out above, those who wish to try experiments on this subject may, perhaps, meet as good hints for them in some of the works of imagination, (where a method of flying has been adopted, either as the foundation of ingenious romance, or as a considerable incident in it), as from any thing that has actually been attempted in balloons.

The method of Cyrano de Bergerac, in his voyage to the Moon, would be too dangerous to attempt in the proximity of the inflammable gas.

That of Rabbi Dillon, in his passage to the land of Dæmons, to receive the fair hand of the sage Princess her royal highness

the daughter of his Satanic Majesty the Emperor of all the Hells, would be not very advisable.

That of the Abyssinian engineer, for prince Rasselas, is too like the methods already attempted for balloons.

That for moving the island of Laputa through the air, is the most scientific, but the least capable of aiding the imagination on this point.

That of Peter Wilkins, though not directly possible, yet furnishes the best hint, especially in conjunction with that of Rabbi Dillon, in his first voyage: his method in the ensuing voyages no doubt would be perfectly effectual; but, it is very doubtful if any modern philosopher could have as much interest with the aforesaid emperor, as the Jewish Rabbi, so as to effect it.

Taking then the hint above mentioned, suppose twenty or thirty eagles, swans, albatrosses, or even herons, were harnessed in a sort of light frame, which would prevent their flying but in one direction, there is no reason to be conceived why they would not draw a balloon, of moderate size, through the air with tolerable velocity, which the aëronaut might steer by a large rudder, formed on the principle of a bird's tail. This method may not be approved; but, seriously, it is not very presumptuous to imagine, that no artificial method of moving balloons, will ever be found out much superior to it with all its defects.

In fact the expense of constructing and filling balloons is so great, in proportion to the weight they can carry, the gas requires to be so often renewed, they are so liable to be torn, from the necessary flimsiness of their materials, and the danger is so great in the descent if the wind should then blow with any violence, that it is not to be expected they will ever serve for any very useful purpose in civil life, even if they could be directed in their course. In a military capacity their advantages have already been found very considerable, and may probably be increased; and it is likely that hereafter they will be entirely confined to this use. For their application in this manner, it would be a very considerable improvement to attach to each balloon a large light level frame, covered with oiled silk, so as to form a plane inclined about 35 degrees to the horizon; which would not only admit of their being used in windy weather, but render them more particularly manageable with a moderate wind than at any other time; for by this means the cord, by which they are on these occasions attached to the earth, retaining the inclined plane against the wind, the impulse of the wind would tend to elevate the balloon instead of depressing it, as it does now; and the aëronaut, by letting out more cord, or by pulling it in, could direct himself so as to hover over any particular spot, to the leeward of his place of ascent as long as he chose; he could also, by a very few cords, (three or four) attached to the different extremities of the inclined plane, so alter its degree of inclination, as not only to raise or lower the balloon without letting out gas, or throwing

forth ballast, but also to make it move considerably either to the right or left by merely depressing a little the contrary side of the inclined plane.

By this method, not only the situation of a hostile army could be more accurately ascertained: but orders or intelligence could be conveyed with safety to an invaded place, and even particular persons might either be conveyed to or from it as required. The means of annoying the enemy might thus be also increased; but the less there is said on increasing or improving methods of destruction, the better.

The only impediment to the flight of a balloon in this manner would be the weight of the cord, which would be considerable, for moving to any great distance; but this might be obviated by attaching smaller balloons, or even smaller inclined planes, to support it at proper intervals: in which way the distance to which a balloon could be sent and brought back under perfect command, might be extended to a great degree.

It would be very advisable to have a similar inclined plane to every balloon to facilitate the descent, which might be made perfectly gentle, even in windy weather, by managing it (after throwing out the anchor) as already described.

Astronomical Observations.—Journ. de Phys.

More particular accounts have been received respecting the new planet Juno, discovered last year by Mr. Harding, of Lilienthal, near Bremen.

On the 5th of September its right ascension was 1°, 52′. Its declination 0°.11′. North.

Mr. Burckhardt observed it on the 23d September at 359° 7′, and 4° 6′, whence he concludes that the duration of its revolution is five years and a half: its inclination is 21°: eccentricity one quarter of its radius; mean distance from the sun, three times greater than that of the earth, that is to say, about a hundred millions of leagues: it is consequently a little farther from the sun than Pallas. Its diameter has not been measured; but it appeared like a star of the eighth magnitude, and nearly equal to Ceres.

Juno is the twelfth planet discovered within a small number of years.

Herschell discovered Uranus and its six satellites, and two new satellites to Saturn: Piazzi discovered Ceres: Olbers discovered Pallas; and Harding has discovered Juno.

Our planetary system is therefore composed, as far as our present knowledge extends, of ten principal planets: Mercury,

Venus, the Earth, Mars, Ceres, Pallas, Juno, Jupiter, Saturn, and Uranus, or Cælum.

And of eighteen secondary planets; namely, the Moon, four satellites of Jupiter, seven of Saturn, and his double ring, and six of Uranus.

In all twenty-eight planets.

And our cometary system is composed of ninety-four known comets.

M. Piazzi, the astronomer of Palermo, has observed a change of one, two, and three seconds in the fixed stars, according to the situation of the earth in its orbit. This determines the reality of the parallax of the fixed stars, about which astronomers have disputed so long, and proves that the distance of some of them is not near so great as was imagined, or that it does not exceed seven billions of leagues.

Juice of the Papaw-tree (Carica Papaya).—Journ. de Phys.

VAUQUELIN has analysed the juice of the papaw-tree *(carica papaya)*, from whence he draws the following conclusions:

"I think," he says, "that there cannot be any doubt that the juice of the papaw is a highly animalised substance; at least it possesses all the characters and yields all the products of one. I confess that it has no perfect similitude with any known animal matter. Nevertheless, I believe that which it resembles most is *animal albumen*; since dried it dissolves like it in water, its solution is coagulated by heat, by the acids, by the alkalis, the metallic solutions, and the infusion of nut-galls. And in fine, because by distillation it yields the same products as any animal substances whatever.

"It is not the animal nature of this substance which ought to surprise us, for the juices of almost all plants contain some of it; but its abundance, and its purity in that of the papaw."

Ascent of Mount Ortelet.—Vienna Gazette.

FOR some years past Doctor Gebhard has been engaged in examining the Tyrol, by order of his royal highness Archduke John. The ascent of Mount Ortelet was one of the most interesting circumstances which occurred on this occasion. A hunter of Chamois was the Doctor's guide in the ascent, who also took with him two boors who had attended him during his excursions among the mountains.

About two o'clock, A.M. on the 27th September, they began to ascend this famous mountain, which is situated between the vallies of Sulden and Drofny, in the Vintsgau. This gigantic mountain, enveloped in eternal ice, is mentioned in the Atlas of Anich as the highest in the Tyrol; no mortal has hitherto dared

to attempt its ascent. According to M. Gebhard's barometer, its height is 14,406 Paris feet above the level of the Mediterranean. Thus, with the exception of Mont-Blanc, the height of which, according to M. Saussure, is 14,556 feet, Ortelet is the highest mountain of the ancient continent. This discovery is the more remarkable, since, hitherto, the mountain of Grossglockner has been considered as the highest in the Tyrol, which, however, does not exceed 12,000 feet.

In a work intended to promote the propagation of useful knowledge, the following paper, (whose object is to restrain investigations within the bounds of reason and good sense) it is hoped, will not be thought misplaced; as nothing can retard the real progress of science more than absurd and chimerical pursuits under the sanction of its name; which, meeting with ridicule and reprehension, prejudice weak minds against the whole of philosophical researches; and give a triumph to the ignorant, in affording them matter of argument suitable to their understandings, against what they suppose to be useless, because they are unable to comprehend it, and to which they are inimical on account of the superiority which science ever confers over them on its followers.

In this paper a Society of Sçavans, who were resolved to set no limits to their pursuits, and who admitted of the propriety of none, are supposed to have proposed the following subjects for determination; by which, in an ironical manner, those of a similar nature, which have really appeared, are justly ridiculed.

Programme of Prizes proposed by a Society of Sçavans.
Esprit des Journaux.

1st. It is proposed to resolve the following problem; the disposition of the fibres of a man being exactly known, to foretell from thence to a certainty how this man will conduct himself in a given affair.

2d. To make the funeral oration of a man whom you have never seen, nor heard speak, from the report of the surgeon who has dissected him.

3d. To point out a method of dissecting a living man, in order to discover if thought be not a fluid more or less subtle, which circulates in the fibres as the blood does in the veins: and to find a method of opening the fibres of some Sçavans who were troubled with a repletion of thoughts, either from having digested them badly, or from not having sufficiently completed them.

4th. To prove that men were organised formerly like fauns, satyrs, and centaurs, (which indubitably existed about three

thousand years ago:) to shew what were the modifications which the species passed through, previous to their arriving at the state of fauns and of centaurs; those through which they have passed since that period, and, in fine, those to which they will in future be submitted.

5. To give a detailed plan of the disposition of an academy of education for ouran-outangs; in order to demonstrate that they are men very superior to the negroes, who were instructed in the house of education in the colonies: to establish a certain rivalship between the two institutions; and to demonstrate the possibility of success, by the simple inspection of the facial angle of the white man, the black man, and the man ouran-outang. Some disquisitions on the perfectibility of the man-paroquet, and also of the man-ass, would not be foreign to this important subject.

6. A discourse on this question: how far society has a right to punish an assassin, of whom all the actions are determined, independently of that which they call the will, by the disposition of his fibres, and by his nervous system.

7. To prove that it is from malice, and in order to bring us back to barbarism, that certain physiologists, such as Roussel, Pinel, and Barthes, have permitted themselves to consider in man what they call *moral*, whilst we, more clever metaphysicians, consider alone the physical necessity.

8. To determine from anatomical observations, what has been, during the last two thousand years, the progress of the civilisation of apes, and to calculate, from the same data, and by means of algebraical operations, the progress which they will hereafter make; in order to fix, at least by approximation, the period when some of them will be worthy to be admitted into our society of Sçavans;—that, in which they will be able to form a philosophical society by themselves; that, in fine, when they will be more perfect than men, and when we Sçavans will be reduced to be only the apes of apes.

Note: It is observed that this period is not perhaps very far distant.

These questions being equally important, the prizes will be equal. They will consist each of a medal of gold, representing, on one side a balance in equilibrio, of which, one of the scales contains a man, and the other an ant; and on the other side a horse riding on a man.

The memoirs are to be sent post paid, and in them care is to be taken, never to cite the names of Locke or Condillac, unless that, to honour their memories, pains are used to prove that they have said precisely the contrary of that which they wished to say, and to guard scupulously against ever pronouncing the words *soul*, *moral*, and such others.

AGRICULTURE.

Facts relative to Mildew with Remarks, &c.—YOUNG'S *Annals.*

THE mass of intelligence which Mr. A. Young has collected from various parts of the kingdom relative to the nature and causes of the mildew, which latterly has been particularly destructive, confers a considerable benefit to this country, and does honour to his patriotic exertions.

From comparing the various accounts published from the above source, the following circumstances appear.

The cause of mildew is now accurately proved to arise from a species of very minute fungus, which inserting its roots into the pith of the plant, absorbs the nourishment intended for the grain, which grain afterwards consists of little else but husk.

The engraving of this fungus, from the drawings of Mr. Bauer, botanical painter to his majesty, as it appeared highly magnified, shew that the seed-vessel of it is somewhat of the nature of the puff-ball, and as its seed is minute in proportion to the size of the plant, the vast number each produces may be judged from what we see in the other fungus; Sir Joseph Banks is of opinion that from the first insertion of the plant to its producing seed is not more than a week in hot weather, and that every pore in the straw where they take root, will produce from twenty to forty plants; and as this seed is not heavier than air, the quick propagation and prodigious extent to which it spreads is hence easily accounted for. The least breeze conveys the seed in every direction, and whenever it finds a proper receptacle, then it directly takes root and propagates its destructive offspring.

There are in all plants a vast number of minute pores intended to absorb moisture from the air, possessing a peculiar mechanism which causes them to *open in damp weather*, and close in dry; these pores, situated in longitudinal furrows in the straw or reed of the grain bearing plants, are, in the opinion of the hon. baronet before mentioned, the favourite niches of the mildew; who also thinks that of all plants it prefers the barberry bush, where it thrives with peculiar vigour, and therefore every barberry may be considered as a strong attractor first, and afterwards a powerful propagator of this noxious fungus.

Every species of fungus thrives best in damp and shade, and some will not grow without them: this shews the reason why in general open situations were less subject to the mildew, and a crop not too thick, but which admitted a free circulation of air among its reed, and also shews why drilled crops from the last-mentioned circumstance frequently escaped, and why damp soils, damp weather, shade of all kinds, and every thing that produced or retained moisture, favoured the growth of mildew.

The fungus also thrives in the site of old dunghills and wherever putrefaction has existed. This shews why damaged crops were in general subject to it, while those which were on a fallow, or followed a crop, which had reduced the manure to mold previously, were much less affected; it is not improbable in this case but that the litter might actually contain the mildew in a state of strong vegetation, and that the farmer might thus in reality plant the mildew at the time he prepared the ground for his wheat.

When the stems of wheat or other grain were well covered with the leaf, provided the circulation of the air was free, it in general kept off the mildew; weakly plants were subject to it from wanting this defence, and barley mostly escaped: and bearded wheat, and other kinds in which the reed is not so much exposed, were not damaged to so great a degree. Weakly plants seemed subject to it from other causes likewise, perhaps from the stagnation of their juices favouring its growth.

It is very probable that the pores (before mentioned) of plants serve the double purpose of absorption and perspiration, and (as every plant is a kind of preaumato-hydraulic engine, in which heat causes expansion of the contained air and fluids, and consequent transudation and evaporation, and cold occasions contraction and by it absorption through the pores) this shews why the mildew was observed to spread most rapidly when the weather was such as produced these exciting causes most strongly and in quick succession; hence a cold night or frost after a hot day, very great damp after much heat, and particularly of that kind of damp which admitting evaporation of itself from the surface of the plant, caused a greater chill to it, while it made the pores open at the same time, were observed to favour the mildew; for a stronger absorption thus taking place, more of the seeds of the fungus would enter the pores of the plants along with the current of moisture, and perhaps also of air, then entering these passages on their way to the internal vessels.

Hot weather is necessary to the growth of mildew; for this reason the crops which admitted of more early reaping, and were thereby less time exposed, and which also escaped the great change of temperature between the days and nights at the end of autumn, were also less subject to the mildew.

Other countries are as much subject to the mildew as this. Italy and Sicily suffer very much from it, and even New South Wales has its crops injured by the same cause.

The small grain (caused by the mildew), though unfit for the mill, is, however, not injured in its vegetating power; and, according to the same respectable authority before-mentioned, is as fit for seed as the plumpest and heaviest grain: because one-tenth of the contents of a grain of good wheat is sufficient for the support of the nascent plant; the greater proportion of farina at present existing in those grains, being the effect of

cultivation more than the nature of the plant; as, in like manner, the apple, pear, and many other fruits, exceed in size of pulp those in the wild state, by the same means.

Of this small grain a less quantity per acre may also be used for seed, inasmuch as every bushel of it will contain a vastly greater number of seeds; and Sir Joseph thinks that three bushels of the small grain will fully equal four of the large.

It seems to be a pretty general opinion, that mildewed crops should be reaped as soon as the grain is filled with its milk, for as the supply of nutriment is cut off by the mildew, evaporation will carry off more moisture than the plant supplies when standing, and thus cause the grain to shrivel, but when cut, the grain being more shaded, dries with less loss of weight.

Circumstances favouring the propagation and increase of Mildew.

Damp and moisture of all kinds, particularly in a stagnate state.

Fog, mist, and evaporation from the soil.

Shade. Thickness of crop. Plants too close to admit free air.

Warmth.

Sudden and great changes of temperature of air from hot to cold.

Calm and still air.

Stable manure and litter in an undecomposed state.

The vicinity of the barberry bush.

Weakly state of vegetation, from whatever cause.

Preventives of Mildew.

Sowing on well-drained and dry soils.

Keeping hedges and other fences low, and enlarging enclosures.

Drilling and dibbling with wide intervals.

Perhaps furrows and drills run east and west, would cause a greater circulation of air, from winds in those quarters being most prevalent.

By choosing kinds of grain which ripen early; early sowing, or by other means to manage so as to reap early.

To use no stable manure for wheat but what has lain in heaps above two years; or never to sow it but after a fallow or preparatory crop.

Removal of the barberry.

Good preparation of the ground, and perhaps paring and burning at certain intervals in the course of crops, to destroy insects, worms, &c. vegetables, stems, or stubble, infected with mildew.

Preferring kinds which have the stems best sheltered with leaves, and heads bearded.

Comparative Culture of Turnips.—Trans. Soc. Arts.

Mr. Wm. Watson in his comparative culture of turnips, for his communications on which he received the silver medal from the Society of Arts, ploughed up ground for the experiment in Autumn 1802, (which had all for many years been under the same course of management); in May and June following it received "three furrows in the common way," and was completely pulverized and cleaned; after which it was divided into four flat ridges, each containing 4719 square feet, the soil was a dry light sandy loam mixed with small stones, incumbent on a thick stratum of gravel.

In the ridge No. 1, the seed was sown in single rows with intervals of 13 inches, after the ground had been manured with dung, more advanced in its putrefaction than usual, which was thinly ploughed in.

No. 2, had drills 26 inches apart on raised ridges, but one-third of the manure was not ploughed in.

No. 3, the same as 2, except that all the manure was ploughed in.

No. 4, sown broad-cast, and dunged in the usual way.

The manure was of the same quality for each ridge, at the rate of fifteen two-horse cart-loads to an acre.

The seed to each was at the rate of 1½ lbs. per acre.

The succeeding weather was very dry, by which many plants were lost. No. 1 lost most. No. 2 was nearest 1, in deficiency, especially in the parts not covered in. No. 4 produced not quite so many as No. 3.

The produce in weight, when heads and tops were cut off, was in stones of 14lbs. each, in

No. 1.	144	10 lbs
2.	193	5
3.	211	4
4.	163	12

The drilling with wide intervals, and ploughing in the manure under the middle of each drill, both admits the same quantity of manure to be spread on a greater extent of land, and permitting the plough to be used in the intervals, facilitates the after-culture, hoeing, and weeding: and though there will not be so *many* turnips produced in number, yet, as each will be much *larger* in this method, the produce will be greater in weight. Mr. Watson accounts for this geometrically, and shews that a turnip eight and a half inches in diameter will weigh nearly as much as three of six inches diameter, because similar solids are as the cubes of their diameters. Mr. W.'s calculation here is not quite correct, the proportion of a turnip of 8½ inches diameter is more nearly as that of 2½ of 6 inches: but this is a very great difference, and so much so in practice, that all the farmers in Mr. W.'s neighbourhood (that of North Middleton in Northumberland) use their utmost endeavours to produce turnips of the largest size, which has induced them

to prefer *drilling on small ridges with large intervals.* The farmers also in Northumberland, Roxburgh, Berwick, and East Lothian, practise the same management, which, together with the *ploughing in the manure under the ridge*, are the chief points in turnip-culture recommended by the result of this experiment.

Method of preserving Turnips in Winter.—Trans. Soc. Arts.

Mr. JOHN SHIRREFF, of Haddington, in Scotland, secured his turnips by enclosing them in stacks, ten feet wide, covered well with straw on every side. He chose a wall for one side of the stack, and drove stakes in the opposite side, the same height as the wall, and parallel to it. The inside of the wall and stakes was lined with compact bundles or sheaves of straw, about ten inches in diameter, introduced as wanted; the largest turnips were placed next the straw; the tops and roots were cut off by women and boys, as they were carted to the stack, and the adhering earth cleaned off: they were then handed up in baskets to the man who built the stack, which, when raised to the height of the wall, (5 feet,) was then gradually contracted, so as to form a roof with an angle of about 45 degrees, then thatched over with straw a foot thick, and roped down with straw bands, which were secured to an horizontal rail, placed for this purpose at the top of the stakes and of the wall: a dry foundation must be chosen or prepared for the stack.

Mr. S. computes the cost of carting, stacking, &c. at £1 14s. 7d. per acre, when the field is not more than a quarter of a mile from the stack.

The advantages of this, he states to be, the having clean turnips always at hand for the cattle, during the winter, in a state fit for use, when field turnips cannot be drawn on account of frost, or, if got at after much labour, are nothing then but a lump of ice. 2d. All loss by rotting being prevented: and 3d. the admitting the plough so much sooner, to prepare for the following crops, so that from the early sowing, and more effectual culture thus permitted, crops are often better, than those in much richer ground, managed in the usual way.

Besides this, Mr. S. kept twenty-six head of young cattle, cows and yearling calves, near three weeks, on the turnip trimmings from 12 acres, with oat straw only in addition, to their improvement; and thinks many more might have been kept with these, had they been provided in time; a quantity of good manure was also procured, both which advantages, estimated at only the value of 3d. for each beast per night, will much more than pay for the trimming and stacking of the produce of the 12 acres.

The gold medal, or thirty guineas, was given Mr. Shirreff, by the Society of Arts, for communicating the above.

Preserving Potatoes.—Trans. Soc. Arts.

Mr. DELANCEY, of Guernsey, received the thanks of the Society for giving an account of the effectual preservation of a small quantity of potatoes, by burying them under the earth 2½ feet, from Oct. 1802, to Jan. 1804.

Observations.—The only novelty in this is the length of time, in which the potatoes were preserved thus; the method itself has been in use in Ireland upwards of 50 years, and perhaps nearly as long in Devonshire and other places: where, for this purpose, a trench is dug, usually, about four feet deep, in a dry spot; straw is then laid at the bottom and sides, and the potatoes thrown in, still laying in straw at the sides as the pit is filled; they are also covered with straw, and the earth taken from the pit is then heaped over all, in the form of a roof. The principal intention of this method is to keep them from frost, and after this is past, they are taken from the pits as wanted.

This is the best method of preserving them in the country: but in cities, for exportation, for ship use, and where small quantities only are wanted at a time, Mr. Millington's method (mentioned in Young's Annals of Agriculture, 1799,) seems superior, of pressing them into cakes, like a thin cheese, of about 4lb. each; in which manner he preserved them perfectly good for three years: in this state they occupied but a sixth of their former bulk, which is a valuable property for stowage aboard ships, and for land-carriage also, especially as they fully recover their former weight on being cooked, and produce full as much food, as the original weight of the potatoes, from which the cake was formed.

Sheep-fold easily removed.—Trans. Soc. Arts.

Mr. THOS. PROWDEN, of Broome, in Norfolk, received the gold medal, from the Society of Arts, for the contrivance of a sheep-fold, whose frames are so placed on wheels, that they can be moved by a boy. Each frame is 3 feet 11 inches high, and 21 feet long, and is formed by an upper and lower bar, each 3 inches deep, and two thick, and three intermediate bars, each four inches deep, and three quarters of an inch thick; seven oak uprights are tenanted into the upper and lower bars, through which uprights, the aforesaid intermediate bars are mortised, thus altogether resembling a gate-frame of the above dimensions; this frame is supported upright at six feet from each extremity by an axle-tree three feet long, crossing the frame at right angles, which is secured to the upright, which stands over it, by an oak knee with screw bolts; the wheels

are about a foot high and of cast iron; one of the axles has a joint at each wheel, by which they can be placed in the position most favourable for turning the frame round.

Mr. Plowden computes that he lost from thirty to forty nights folding, when he used common hurdles, in the course of each year, from the ground being too hard to drive in the stakes, either from drought or frost: the frame above described, being moveable at all times, prevents this evil, and also save the loss from wear, which must be considerable, on the common hurdles, from the violence to which they are liable in driving: moreover, as these frames can be moved by a boy, and the others require a man to attend them, the difference between the wages of the man and the boy, Mr. P. thinks, will enable small farmers, who possess but 50 or 100 sheep, to have the benefit of folding by the use of this implement.

Observations.—The only parts of this contrivance, liable to be easily put out of order, are the joints at the wheels; but this is easily remedied, by having a round upright in the centre of the axle well secured to it, by a knee or brace, which upright should be attached to the frame by staples, so as to permit it turning within them; this contrivance would substitute one firm joint in the place of two weak ones. The frame might in this case either be supported by the axle, or the head of the upright, whichever was preferred.

But, as the frames are not very heavy, it seems still better to use but two wheels to each, (instead of four,) placed about a third of the length from one extremity, with a foot at the other end, to raise it to the level with the wheels, (which might be formed by leaving the upright at that end so much longer than the rest,) then by raising this extremity, the whole might be moved, as a hand-cart, or wheel-barrow; a handle might be added to the frame, like a plough-handle, to facilitate this operation, if thought necessary, or a staple fixed to admit a moveable handle. It would also make the frame stronger, to have a diagonal or two placed between some of the uprights; which addition would admit its being made lighter, with equal strength, and permit the substitution of dove-tailed or plain joggles for mortices, through the whole frame, which would save the most expensive part of the workmanship.

Improvement of Drains.—Trans. Soc. Arts.

J. C. Curwen, Esq. Cumberland, received the gold medal from the Society of Arts, for his communication relative to drains.

He remarks that Mr. Elkington's method of draining is not universally applicable, because the different strata are frequently interrupted by vertical partitions of several feet thickness, called dykes or fissures, which will not permit the water to pass, so that a drain may run within a few feet of a very wet spot, without drawing any water from it, if one of those dykes intervene. In a country where these dykes occur, Mr. Elkington's method would only drain the interval between two dykes.

It is very necessary to find out the direction of these dykes. Mr. C. drew but little water from his ground when he ran his drains in the same line with them; but by altering the position of the drains and making them deeper, he succeeded effectually.

Mr. Curwen recommends always to begin with the upper levels, for that frequently drains the whole, and from his experience he is of opinion that all *springs proceed from dykes* which stop the water in the horizontal strata; some of these dykes may be traced for miles, by their effect exhibited in the water which appears on the surface. He does not wish to detract from the merit of Elkington's method, but to state its not being proper for countries when the strata are much broken.

The kind of drain used by Mr. C. is a union of the covered hollow drain, and of the drain formed by loose round stones, in many places called French drains, which last is placed above the first.

The hollow drain below leaves an interval of nine inches square for the water to pass; the side stones are near four inches thick; these are covered by flat stones, over which loose stones are thrown in to within nine inches of the surface; and over this the grass sod, and soil are put to the level of the ground above. The top of the drain is twenty-two inches wide; the expense of cutting was from fourteen to eighteen pence per rod; filling, eight pence; stones, eight shillings: in all about ten shillings per rod. But Mr. C. thinks the efficacy and durability of these drains fully pay for this heavy expense: in twelve months he made 6000 yards of such drains.

Observations.—The depth of the drain is not mentioned, but if the section of it be made by a scale, it must be more than 4 feet 6 inches deep, as it is upwards of five times the depth of the hollow passage for the water, stated at 9 inches. There is a little inaccuracy in the dimensions of the parts at the bottom of the drain given; for the bottom of the excavation is mentioned to be but 12 inches broad, and yet the two upright stones placed within this space, are directed to be from 3 to 4 inches thick each, and the interval between them to be 9 inches, which would exceed the given space by 3 or 4 inches.

A plan of the drainage is referred to in the paper which is not given in the printed copy. The highest drain is stated to be 120 feet above the level marked No. 3 in this plate.

Oil from Seed of the Gilly-flower.—Bib. Phys. Econ.

M. SONINI greatly recommends the cultivating of the gilly-flower (Hesperis Matronalis), for the produce of oil, as its seeds yield it in greater abundance than any of those in common use: the proportion obtained from 30lb. of rape seed was seven (Paris) pints and a half of oil, that from the same quantity of hemp seed was five pints, while 30lb. of gilly-flower seed yielded no less than eight and three-quarter pints of good oil, which burned well in the lamp, gave a bright light, lasted longer than most other oils, and produced no disagreeable scent; its only defect was that it produced much smoke.

The cultivation of this plant is attended with but little trouble; when the seed is once sown the plant renews itself spontaneously every year, and produces a fresh crop. It will flourish on very poor soil, five inches of earth over a rock has been known to be sufficient for it.

Good ground will, however, produce a greater crop; M. Sonini sowed some of this seed in ground well manured, in the month of October, which was covered with but little earth; in the following year the plants were more than four feet high, and threw out a multitude of branches. The flowers appeared the second year: the produce of seed was in the proportion of 19 lbs. to every fifteen square feet.

M. Sonini thinks this plant is only a biennial in reality; but the seeds, which drop of themselves, take root so effectually, and produce so well, that it causes the same effect as if the plant were perennial. The only culture it requires is to hoe the ground in the beginning of spring to destroy the weeds, and to renew the decayed plants, by offsets taken from the others. M. S.'s ground, managed in this way for ten years, did not fail to produce every year with the same vigour and abundance. It stood the most severe frosts in Lorraine, where they are more violent than in the centre of France, without injury; and the acrid taste of the whole of the plant effectually keeps off all sorts of insects, so that it receives no sensible injury from them.

It is recommended to sow this plant with a crop of buck wheat the first year; from whence and what precedes, it appears it may either be sowed in spring or autumn. The plants should be left eight inches apart from each other, in every direction.

Observations.—This plant seems well worth an experiment from some of our own agriculturists, who no doubt might find a better crop than buck wheat to accompany it: beans, for instance, seem likely to be preferable.

As to the smoke the oil produces in burning, it is probable it may be caused by an excess of mucilaginous matter, which might

be removed by metallic oxydes, or perhaps more cheaply by pounded charcoal, which has a strong attraction for mucilage.

M. Sonini expatiates greatly on the beauty and fine scent of the flowers, which are very abundant on this plant; this circumstance shews its utility in another point of view, as it is likely the flowers would afford a copious source of honey and wax.

There is no doubt but other plants as well as this, now only cultivated in flower knots, would produce seeds proper to yield oil, and perhaps in greater abundance. A very oleaginous seed of the shape of buck wheat, but somewhat larger, is produced from a very common plant, of which the name, as well as can be recollected, was the hyacinth or blue bell, which might be tried for this purpose.

On preserving Potatoes for several Years.—Ann. des Arts, &c.

M. Dervieu (stated to be a cultivator of his own estate at Reugny in the department of the Nievre), asserts, that in 1790 he sent an account to the Society of Agriculture at Paris, of the result of several experiments made on no less than four thousand bushels of potatoes, of which the principal was the following: he bruised them in the same manner as they prepare apples for cider in Normandy, that is in a circular trough with a vertical mill-stone, drawn round by a horse, after which they were submitted to the action of a press. When the marc (pressed matter) was well drained, it was cut into squares of 8 or 10 inches, which were placed to dry in a sheltered situation.

Potatoes treated in this manner produced,

1st. A great quantity of vegetable water, which was given to the cattle and the pigs.

2d. A quantity of fecula, of which 27 quintals were sold to the linen-manufacturers of Morlaix.

3d. and lastly, the marc, which after being dried, served for two succeeding winters to feed the breeding ewes and their lambs.

He mentions that he feels peculiar satisfaction in announcing that an economical process which was only tried in miniature, to the amount of a few pounds weight, in a London laboratory, has been practised, and probably is still, on a great scale on the banks of the Seine. He also claims the priority of the discovery, for which he refers for proof to the suffrage of the Society of Agriculture at Paris, registered in the account of their proceedings published in December, 1790.

Observations.—The English experiment alluded to in this account, is probably that of Mr. Millington, who presented a cake

of potatoes (pressed in a similar manner to that described) to the Society for bettering the Condition of the Poor in London, in the year 1799; the cake was made in 1797, and was perfectly good at the time presented.

If it were not for the reference above stated to the journals of the Paris Agricultural Society, there would be some reason to doubt the date of the French experiment, as it has not been mentioned in any of the periodical works before this year, 1805; and besides, it is not many years since the use of potatoes was so little known in France, that they have been recommended by their writers to the attention of the people, almost as if they were a new discovery. Mercier, in particular, is remarkably eloquent on this topic, and has a paper on the subject which is almost poetical.

Another suspicious circumstance is Mr. Dervieu's recommending the use of the marc for fuel: when it is prepared, he says, the marc is put to dry in a covered place, and it will then "serve for fuel:" surely if it were so good a food for sheep, no farmer would ever think of using it in his fire-place.

Whoever may be the first inventor, there is no doubt that the invention is of value: though it does not appear that its best application is that stated here: to preserve potatoes for use in the country, the least troublesome method seems that of burying them in trenches lined with straw under ground, practised in Devonshire and Ireland (mentioned in another part of this Number). But the method of preserving them by the press, seems extremely valuable as a preparation to make them serve for sea store, and for exportation, as they would in this way occupy not above a fifth of the space in the ship they would unpressed, and besides would keep perfectly good for a great length of time; this is of the more consequence, as sailors in general are very fond of them, and they might, used in this way, tend to save much of the consumption of biscuit.

Unless the fecula (produced in the pressure) sold to the starch-makers, would produce more profit than appears at first view, it does not seem to be very well worth while to prepare them in this manner for food for cattle, as the method before mentioned seems fully sufficient for their preservation for this purpose.

On Feeding Sheep with Potatoes.—YOUNG's *Ann. Agric.*

MR. ROBERTS, of Beaulieu, Hants, has transmitted to Mr. Young a very favourable account of trial of potatoes for feeding sheep. In April, 1803, he planted ten acres of potatoes in drills,

housed the crop in October, and covered it well with straw and fern, and in the middle of March, when his turnips were exhausted, began to use them for all his cattle, and found them an unspeakable treasure, and by their assistance kept his whole stock in excellent condition to the end of April; he computes this advantage to pay him at the rate of full 20*l.* per acre; they were particularly serviceable to his ewes and lambs at that trying season. To prove that these roots do not exhaust the ground more than turnips or carrots, Mr. R. mentions that he had five quarters six bushels of barley per acre off the same land after the potatoes, exclusive of the tithe, which was drawn in kind.

The following year Mr. Roberts planted forty-three acres with patatoes, the produce of which kept during the winter (from the second week in December) all his stock, consisting of 12 bullocks, 165 South Down wethers, 18 barren Leicester ewes, 87 South Down ewes, 40 store pigs, and 95 swine put up for fattening; besides which he sold twelve hundred bags at five shillings per bag, and expected to have still more to sell at seed-time.

The bullocks and sheep had always plenty of good hay within their reach; but they eat very little of it, preferring the potatoes; they were given to the cattle raw, unwashed, and whole; the 95 fattening swine were fed on steamed potatoes only, and throve rapidly.

This account confirms the advantages of the same management formerly stated by Mr. Forster, of Royston, in the same work. This gentleman having purchased 200 South Down ewes, and having only 10 acres of turnips to winter them, resolved to apply 300 bushels of potatoes, which he had by him, to the same purpose, and found them answer extremely well; the 100 sheep had five bushels of potatoes every morning, with fresh straw twice in the day, after the hardness of the frost prevented their being any longer folded on the turnips; with this food, and turnips occasionally as the weather permitted, they throve very well through the winter, and produced 100 lambs, though the fall of lambs was remarkably bad that spring, and some farmers lost half their lambs, in consequence of their ewes having but little milk through poverty.

The next year he had five acres of potatoes which produced 200 bushels per acre, and, his turnip-crop having failed, the flock were kept solely on potatoes and fresh straw night and morning, through the winter; and at Lady-day the ewes and lambs were allowed to be in better condition than any flock in the neighbourhood; besides what seven score sheep consumed, Mr. Foster sold as many potatoes as paid him five pounds per acre; the land was ploughed up immediately after the potatoes were taken up, and drilled with wheat, at nine inches intervals; the crop was equal to any other there. This success induced several in the neighbourhood to follow Mr. F.'s example.

The potatoes were given whole to the sheep in this instance in troughs; for the first day or two they did not eat many, but after that time the only trouble was to keep the sheep from running over the feeder, they were so fond of this kind of food.

Experiments on Manures, (on a small scale).

By Mr. A. Young.—Ann. Agric.

Mr. Young has published the results of experiments in miniature on manures; he has condescended on this occasion to shift his style of experiment in a remarkable manner, for acres and fields, flower-pots are substituted, and the produce computed in grains, instead of his customary tons and quarters. Experiments of this nature, when conducted fairly and accurately, as those here recited, cannot fail of being useful; and from their facility, may be multiplied and varied to an extent which is impossible on a larger scale, and knowledge acquired and extended with proportionable rapidity.

Mr. Young has done more service than probably he was aware by this publication; after his example, who will presume to call this mode of experiment trifling, think light of the knowledge to be gained by it, or be ashamed of stating its results to the public beside more gigantic agricultural investigations? He has thus opened a new entrance to information, whence this very useful pursuit may derive hereafter most important light.

The design of many of these experiments was to investigate the nature of manures in general, or of the nutrition of vegetables, as appears from the species of the substances employed; several, however, give more direct practical information, and their results are capable of being applied at once to agricultural purposes.

Earth of the same quality was put into a number of pots six inches deep, which were, as nearly as could be chosen, six inches diameter; in each of these one of the different substances were tried as manures mentioned in the following table, and ten grains of barley planted in every one of them.

The Numbers of the pots are the same as those in Mr. Young's tables; opposite to each is a statement of the relative value of its produce on adding together the number of grains of corn and weight of straw produced; they are arranged according to the order of merit.

No. 16.	Half an ounce of pearl-ash and half an ounce of charcoal in solution - -	715
31.	Straw steeped three days in stable urine -	473

No. 19.	Rich loam from Holkham, in Norfolk	320
64.	Pearl-ash one ounce, spirits of nitre one ounce, and two ounces of water	296
60.	Soda one ounce	291
41.	Soot one ounce	289
32.	Chalk two ounces, salt half an ounce	269
35.	Gypsum one ounce	244
61.	Bay salt one ounce	212
22.	Salt three-quarters of an ounce	196
27.	Straw steeped 15 hours in stable urine	193
21.	Salt half an ounce	188
25.	Straw steeped three hours as before	188
17.	Hemsby loam (in Norfolk)	185
33.	Chalk two ounces, salt a quarter of an ounce	177
37.	Chalk one ounce, gypsum half an ounce, spirits of hartshorn half an ounce	177
63.	Magnesia one ounce	177
24.	Salt one ounce and a quarter	167
14.	Pearl-ash half an ounce	167
36.	Chalk two ounces, gypsum half an ounce	164
23.	Salt one ounce	151
59.	Nitre one ounce	148
15.	Pearl-ash half an ounce, charcoal half an ounce, in dry powder	146
34.	Chalk two ounces	145
35.	Gypsum one ounce	144
28.	Spirits of hartshorn one tea-spoonful	142
62.	Iron filings one ounce	140
26.	Dry straw half an ounce cut small	139
20.	Salt a quarter of an ounce	136
13.	Charcoal half an ounce powdered	128
57.	Gum arabic 1 oz. spirits of wine 2 oz. stone blue one ounce Salt of tartar 1 oz. spirits of hartshorn 2 oz. water 3 oz. — four spoonfuls	128
44.	Salt 30 grains	105
39.	Soot 80 grains	96
2.	Spirits of wine one tea-spoonful = one-sixth of an ounce	95
29.	Spirits of hartshorn two spoonfuls	93
8.	Mixture (of 500 grains of stone blue, in one pint of water) one ounce	92
43.	Salt 15 grains	92
40.	Soot 160 grains	88
6.	Mixture (500 grains of stone blue, 500 grains of pearl ash, one pint of water) one ounce	87
42.	Gypsum 30 grains	84
54.	Chalk one ounce, hartshorn one spoonful	82

47.	Gypsum 20 grains	79
52.	Mixture (same as 57) two spoonfuls	78
11.	Mixture (250 grains soap, two ounces spirit of wine) half an ounce	78
4.	Spirits of wine four tea-spoonfuls	77
55.	Mixture (same as 57) three spoonfuls	76
38.	Chalk one ounce, spirits of wine one spoonful	74
30.	Spirits of hartshorn three spoonfuls	73
50.	Spirits of wine a quarter of a spoonful	68
56.	Charcoal 183 grains, spirits of hartshorn one ounce	63
49.	Spirits of wine half a spoonful	63
3.	Spirits of wine two spoonfuls	60
1.	No MANURE	57
9.	Same mixture as 8, two ounces	55
7.	Mixture (same as 6) two ounces	54
12.	Mixture (same as 6) three ounces	48
5.	Spirits of wine three spoonfuls	46
10.	Mixture (same as 11) one ounce	28
58.	Mixture (same as 57) four spoonfuls	28
45.	Salt 20 grains	26
53.	Gypsum 20 grains, and two ounces of mixture (one ounce of gum arabic in three ounces of water, and spirits of wine two ounces)	25
48.	Mixture (same as 57) one spoonful	17
18.	Poor sand and mixture same as 53	11

The principal circumstances which Mr. Young remarks in these experiments, are the strong proof which experiment No. 16 gives of the *solubility of charcoal in water by means of pearl-ash*, effective as a manure; for the charcoal and the pearl-ash separately have each an effect far inferior, though both good manures.

2. That the effects of dry straw should be so great, is worthy of notice.

3. Salt seems to have a powerful operation as a manure, and in the largest quantity used in our experiment had the effect of counteracting a great drought.

4. Nitre was observed to have considerable effect.

5. Gypsum was beneficial in every instance, except one, which was most probably caused by the mixture added with it.

6. Spirit of wine was of some service in very small quantities.

7. Spirit of hartshorn appears to advantage; and as the less the quantity used, the better was the produce, it is probable that smaller proportions might have still more beneficial effects.

Observations.—The writer of this article tried a few experiments of a similar nature to the foregoing, four or five years ago, with a view to ascertain the effect of charcoal-dust as a manure, and recollects perfectly well that the plants in the

flower-pot, in which plain charcoal dust was used as a manure to common earth from a ploughed field, was in all appearance equally flourishing, as those in that manured with horse-dung; liver of sulphur, or sulphuret of potash, which is considered as having a strong power of rendering charcoal soluble, was used with charcoal dust as a manure in another pot with this view, but in this the plants all died; perhaps smaller portions of the sulphuret might not have so bad an effect.

An additional proof of the solubility of carbonaceous matter caused by alkaline substances, may be seen in a paper on Indian ink in the Repertory of Arts for May.

On the fertilising Effects of Ashes containing Sulphate of Iron, and of a Substance called Peat Dust consisting almost entirely of the same Salt.

By Dr. W. Pearson.—*Trans. Agricultural Board.*

Mr. Williams, of Tingrith, in Bedfordshire, having applied to Dr. Pearson to examine the nature of a substance called peat-dust, used in his neighbourhood as a manure, which had a saline appearance, Dr. Pearson, on submitting this substance to the operation of divers re-agents, clearly ascertained that it consisted of sulphate of iron for the greater part, with a little lime united to sulphuric or carbonic acid, and a minute proportion of silicious earth, and that there was no trace in it of magnesia, argil, or the uncombined alkalis.

All metallic sulphates being generally considered inimical to vegetation, the Doctor thought a fact so extraordinary as the above well worth communication to the Board of Agriculture, and accordingly sent an account to them of whatever information he could obtain on the subject. In this account the following circumstances appear.

Peat Dust.

This dust is a grey saline substance, obtained by beating the earth which contains it to a powder; it is found in particular spots, the earth not affording it equally in all places; it has been known as a manure above six years, and on trial increases in reputation and demand.

2. Fifty bushels of this dust are the proper quantity per acre. This should not be exceeded, as a too great abundance has a deleterious effect.

3. It is used for clayey or wet lands.

4. On grounds of this kind, of a cold nature, it much improves the vegetation of sowed grasses and old pasture, and the production of corn.

5. It is not mixed with lime or any other substance.

The farmers send waggons for this dust from some distance, and higlers likewise buy it, and carry it for sale many miles, as they do likewise the ashes procured by burning the surface of the peat.

Peat Ashes.

The turf or surface, and such parts of the peat as do not appear to be of the best quality for domestic fuel, are laid up in considerable heaps and reduced to ashes, which are of a red colour.

1. These ashes have been long used as a manure, and their demand is on the increase.

2. The quantity used per acre is 50 bushels.

3. It is laid on gravelly, sandy, or chalk soils, of a dry nature, such as are burnt up by a long continuance of hot weather. It is most commonly used for grasses, but is in considerable esteem also for oats or barley, on land of this description.

4. The fertilising effect of it is surprising, as it will double or treble a crop of new-sown grass, such as trefoil. It effectually destroys moss on old pastures, and produces Dutch clover in its place. The effects of this manure may be traced to an inch, so strong is the contrast of the appearance of the manured and unmanured places. Near the fire heaps, as far as the ashes are driven by the wind, the production of white clover is sure to be abundant. These ashes are equally favourable to the growth of barley or oats.

5. They are not mixed with lime or any other manure.

These ashes are carried by higlers on asses in sacks to such distances that they must come very dear to the consumer.

Peat.

The peat itself is used as fuel by the poorer sort of people on brick hearths: it is dug into the usual form for this purpose one spade's depth, after the turf or exterior surface is removed; this matter renews itself again in about 15 years, and the whole moor is divided into proper portions, and periodically cut once in that period; if the above-mentioned depth be exceeded, the reproduction is prevented. This species of peat corrodes all iron grates in which it is burned, and vessels for cookery used on it; gives a bad taste to meat roasted by it, and injures furniture by its effluvia and dust.

Further Testimonies.

Besides the above accounts of the fertilising qualities of these substances conveyed to Dr. Pearson by Mr. Williams, a letter is inserted in the report from Mr. J. Anstey, of Houghton Regis,

that he has used the peat dust and ashes of Tingrith moor for above 30 years as a manure, and lays on sometimes from 80 to 100 bushels per acre; it encourages vegetation in moist warm weather, but the reverse in dry hot weather. The land in Mr. H.'s neighbourhood where it is used is dry and thin stapled, owing to the *chalk rock* lying near the surface.

There is a letter also inserted from Mr. Barton of Philadelphia, mentioning some experiments made on vegetation, in which he found that branches placed in *solutions of sulphate of iron and of copper, lived longer, and exhibited more signs of vigour, than similar branches placed in simple water.*

Professor Robinson, it is mentioned, asserts that peat ashes always contain a very great proportion of iron, and that in three places, which he has seen in Russia, where there was superficial peat moss, *the vitriol was so abundant as to effloresce*, and that particularly on a moor near Petersburgh the clods of earth shew the vitriol of iron every morning when the dew has evaporated.

Dr. Pearson estimates the quantity of 50 bushels per acre of peat dust, mentioned by Mr. Williams, to be equal to 2250 lbs. averdupois, and to give near seven and a half ounces per square yard.

There are also inserted some observations on the fertilising effects of pit-coal ashes, for grass (which Mr. Greger found to contain sulphate of magnesia, and sulphate of lime, especially the former) and on the use of wood ashes for the same purpose, both of which circumstances having been known before, need not be enlarged on here.

Observations.—A great source of error attending discoveries of new facts, arises from a propensity to generalise them too much. Dr. Pearson seems on this occasion inclined to this error, in attributing the effects of *all paring and burning* to the oxyd of iron, or sulphate of iron, produced or made apparent by this operation; which effects are more likely to be caused so universally by the carbonaceous matter, which certainly is always produced by the burning; whereas it is so far from being proved that all soils produce oxyd of iron in sufficient quantity to have any considerable effect, that there is great reason to believe, that several contain little or no iron, where paring and burning are very effectual.

Dr. Pearson attributes the corrosive effects of this kind of peat on grates and metallic vessels, when it is used for culinary fuel, to the *lignic* acid produced. But this effect seems much more likely to be caused in this instance by the sulphuric acid driven from the contained vitriolic salts by the heat; for if it was occasioned by the *lignic acid*, all peat would have the same effect, which is by no means the case, as may be known in the many places, both of the united kingdoms and on the continent, where peat is used as fuel in every apartment of houses of the first people, without injuring either grates or furniture; wood fuel would like-

who have the same effect, which, as well as peat, produces the ligne acid in burning, and even gives to it its name.

Though peat in many places gives red ashes, yet there are as many also where its ashes are perfectly white like those of dry wood, which shews that the produce or presence of oxyd of iron in all soils is not so general as the Doctor supposed.

The facts are undoubted that the ashes and peat dust of Tingrith moor have fertilising effects, and that they contain abundantly sulphate of iron: all, however, that can be strictly inferred from this is, that it is very probable that ashes of other soils containing the same salt would have equal effect, and that sulphate of iron *may* have a fertilising power.

But it should be submitted to the test of careful experiment to determine how far sulphate of iron, by *itself*, would have the same effect, or whether any of its efficacy depends on a combination with carbonaceous matter, or on the soil in which it is used.

The latter seems somewhat probable, as in Mr. Anstey's letter there is mention of *chalk rock* lying near the surface in the soil where he used it. As in such soil sulphate of iron would operate, by a double decomposition, to set free abundance of carbonic acid from the chalk, (which has been proved by Monsieur Senebier and others, to greatly assist vegetation), it makes the effects of the sulphate of iron individually the more doubtful.

Of the Sulphate of Iron.

If after careful trials it should be established that sulphate of iron has by itself a fertilising power on all soils (which is not as yet by any means so manifest or well proved as Dr. P. is inclined to reckon it), it will then remain to determine how this salt can be procured sufficiently cheap for the amelioration of land in situations which have not the same advantage as the neighbourhood of Tingrith moor.

Perhaps for this purpose copperas stones, (ferruginous pyrites) which are found in abundance in the Isle of Wight and elsewhere, might be used to advantage, broken small, or ground, and spread in proper proportions over the land.

Copperas itself, as sold by the manufacturers of it, is too dear to use it on ground in any sufficient quantity, being sold wholesale at the rate of 11s. 4d½. at an average, per cwt. which would occasion a cost per acre, at the rate stated by Dr. Pearson, (2250 lbs.) of 10l. 7s. for which the advantage must be great and permanent to pay the expense.

Whether farther trials shall prove the universality of sulphate of iron as a fertiliser, as Dr. Pearson asserts, or shall confine it to particular soils and situations only, the public are no less indebted to this gentleman for pointing out an addition to this most valuable class of substances (manures), not generally known before.

The price paid for the peat dust, of four pence per bushel,

comes to but 16s. 8d. for each acre, at the rate of 50 bushels per acre, (or 10l. 7s. as stated above) which is vastly inferior to the value of the sulphate of iron Dr. Pearson asserts it contains: perhaps for this reason, it would be a more profitable use of the peat dust and ashes of Tingrith moor to lixiviate them, and concentrate and crystallise them, to produce copperas for sale, than to use them for manure.

On Paring and Burning.—YOUNG's *Ann.*

Mr. YOUNG has carefully examined the effect of paring and burning in several different counties on various soils, and his reports are decidedly in favour of this practice: on some soils, where this management was customary, the effects of fallowing and other modes of proceeding have been tried in its place, with uniform ill success; and in the very few instances in which it was not evidently serviceable, there were proofs of gross mismanagement in other respects, sufficient to exonerate it from the imputation of being the sole cause of an indifferent produce.

Soil.

On peat, moor, fen, and boggy soil, the advantage of paring and burning is indisputable; on peat immense crops of oats were gained in consequence of it: on fenny soils, it is the general opinion not only of farmers but of enlightened landlords, that they cannot be managed to advantage without fire; and even those "who question it as a general husbandry," admit the necessity of beginning with this operation.

2. On thin loams over chalk (which is the soil of Newmarket heath) vast tracts have been pared and burnt with good success.

3. On sandy soil in Bedfordshire, where it was used by some professional gardeners, the success of it was great; though another trial was not so fortunate; but in this instance it was used as a preparation for barley early in the spring: it also failed under Mr. Jebb's management on the black sand of Bagshot-heath. On the sands of Sussex its success has been complete with Mr. Seton, and "sufficient alone to establish the practice."

4. On loam and clay the result is uniformly in its favour, with one solitary exception, which, in the same parish, is opposed by numerous successful trials. "The experiments on this soil are so clear and satisfactory, that no doubts remain on the mind of the reader."

Of these four soils, the practice has been found best on peat, loam, and clay; good on chalk, and only doubtful on sand.

Season.

From the information received by Mr. Young, it appeared,

that the paring should be done in spring, and the burning performed as the weather might suit, so as to finish in time for turnips, cole, or cabbage, but never should be hurried over imperfectly, in order to get in barley or oats.

Depth.

On peat land, the depth used is from one inch to an inch and half for paring. On Newmarket heath the depth was one inch.

Burning.

It was the general opinion every where, that burning should be very carefully performed, to prevent over-calcination. A *black ash*, with much *half-burned turfs*, is preferred to converting the soil into red ashes: for this purpose, the heaps do not cover more than a circle of three feet diameter, or at most four.

Spreading.

Mr. Young thinks it undecided, whether it is best to spread and plough in the ashes immediately after burning, or after exposure some time to the atmosphere. One gentleman prefers, from experience, to plough the ashes in fresh from burning for coal; another found long exposure, after spreading, very superior for wheat, and that the parts where the ashes lay in heaps, or the paring was performed late in summer, did not succeed well.

Effects of Fire.

In various instances Mr. Young observed a remarkable superiority in the produce of the spots where the turf was burned, though it is the universal practice to shovel the ashes quite clean from those spots with some of the earth also: from examination of the soil before ploughing, no superiority or general friability of soil was observed in those spots sufficient to account for this fertility; and the destruction of worms and insects in them is totally inadequate also for this effect. Mr. Y. therefore seems inclined to impute it to some undiscovered retention of latent heat.

A vast deal of useful and interesting miscellaneous matter accompanies the proofs and observations on which the above facts are founded, in which the account of the deplorable state of the low grounds in Cambridgeshire is most worthy of notice, and is most feelingly described: the water here is rapidly resuming its empire over lands of the greatest fertility, and a tract of country capable of producing a million sterling annually, gradually sinking to destruction: in 1795, there were 141,000 acres flooded, and nearly as much in 1799 and 1800: and in one place, after an uncommon drought, so late as the month of July, Mr. Y. observed no less than 70,000 acres, which had been so lately under water, that the spring crop was lost, and damage done to a vast amount.

Mr. Y. observes, "land here, now to be purchased for from "4 to 10l. per acre, which, under a secure drainage, would sell

"at from 20l. to 30l.: two or three more floods will complete "the ruin; and 300,000 acres of the richest land in Great Britain "revert to their ancient occupiers, the frogs, coots, and wild "ducks of the region."

A proper drainage, which is very feasible, would remedy all these evils; and Mr. Y. calls, with propriety, on our parliament to lend aid to this measure, by which so large a tract of country, unrivalled in fertility, in times of such scarcity, may be restored to its former productive state.

Mr. Y.'s observations on the magnitude of the wastes in various parts of the kingdom, and the great capability of most of them being made eminently profitable, are equally striking: he concludes them with this remarkable sentence:—

That "were it possible for any great assemblage of the people "to be justifiable, it would be one in every avenue to parliament, "for shouting in the ears of the members—CULTIVATE THE "WASTES."

Mr. Y. found, that paring and burning was first introduced into Cambridgeshire by a colony of French refugees, in 1653, who were driven by persecution from France to Holland, and thence to Thorney.

Observations.—From the facts above stated, there can be no doubt of the benefit of paring and burning on most species of soil when properly managed: a vast body of proof, to the same purpose, might be collected in Devonshire, where the practice has been in use from very remote periods, and whence it derives its name of *denshiring*. From the facts relative to the burning, it is very evident that the most proper management for it, is that which will produce, not most ashes, but most *carbonaceous matter;* and that, therefore, when the vegetable fibres and roots, contained in the burning heaps, are arrived to the state of coal, or become thoroughly red, the fire should be extinguished, by covering the heaps with earth, as it is probable that all farther burning wastes the fertilising matter instead of adding any thing to it.

From the experiments made by Mr. Young, stated in a foregoing paper, on manures, and from various other experiments and facts well known, and from what has been written on the subject by Monsieur Senebier and others, there can now be no doubt of the fertilising power of carbonaceous matter, and very little, that the chief, if not the only beneficial effect of burning soil is to produce this matter.

This accounts for the soil being more fertile where the heaps were burned, as in such places the roots and vegetable fibres remaining in the earth, must have been charred to a considerable depth by the heat, and perhaps the gaseous carbon and carbonic acid, produced in burning, might also be absorbed by the soil underneath.

The effects of carbonaceous matter as a manure, are principally

ture; it attracts water strongly from the air, for the use of the plants, and also nourishes them by its own decomposition, whether it passes into a gas absorbable by water, or, as Mr. Senebier thinks, into the state of carbonic acid, and enters the plant in solution with water. To this decomposition atmospheric influence is highly conducive, and light and heat perhaps absolutely necessary, along with moisture, which, as observed, it attracts naturally; for these reasons, it is very probable that the burned heaps should be used rather as what is called a *top-dressing*, than be buried under the plough; as in the first case they would be more exposed to the action of those agents mentioned, which convert carbonaceous matter into a state fit for solution in water, and thereby for entering vegetable vessels.

The good effects of paring and burning are not so uniform on all soils in other parts of England as in those examined by Mr. Young. In some parts of Devonshire, as is reported from good authority, they do not find it do so well on strong stiff clays, such as the soil of the vale of Taunton Dean, and that in the neighbourhood of Bridgewater: this probably is occasioned by the heat baking the clods of this soil into a sort of bricks, where its influence extends; and might perhaps be remedied in such places by paring thin, so as to take up as little earth as possible with the vegetable mat of roots and stalks which covers the soil, and by making the heaps very small, so as to occasion no very intense heat in any one spot.

In burning peat soil a caution of a different nature seems necessary; from its consisting almost entirely of combustible matter, there is great danger of much being consumed to loss, or to produce no adequate advantage: this may be prevented by bringing clay or earth from the neighbouring grounds to cover the burning heaps, by which the fires could be properly regulated, and extinguished when thought fit. It is extremely probable, from many facts and observations, that *peat-mold charcoal* would also make an excellent manure for other ground. The experiment is the more worthy of a trial, as, if it were found to succeed, of which there is little doubt, an inexhaustible supply of manure would be thereby afforded in numerous situations where it is much wanted.

Mr. Young has not noticed the effect of lime with paring and burning, whence it may be inferred that it is not used in the places which he has examined.

In Devonshire, the use of lime is universal as a top dressing, after the burned heaps are spread and ploughed in; and every where in this county proof abundant may be found of its increasing the produce very considerably; for this purpose the lime is left in small heaps, covered with a coat of earth, for a considerable time before it is used, till it has slacked and fallen very fine: about 60 bushels of lime is used to the acre of English lime, and 40 of Welch lime: the latter is preferred.

RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. II.] *May, June, July, August.* [1805.

CHEMISTRY AND MINERALOGY.

Experiments on the Gases obtained from the Distillation of Wood, Peat, and Pit-Coal.

By Mr. Wm. Henry, *Manchester.—Phil. Jour.* No. 42.

In consequence of the interest which is now taken in the method of producing an excellent light, in the cheapest manner, for large consumption, from the combustion of the gas procured by the distillation of pit-coal, Mr. Henry was induced to make experiments on this substance both analytical and comparative.

Mr. Henry tried hydrogen gas, carbonated hydrogen (obtained by passing water over ignited charcoal), and carbonic oxyd; but found that each of them burned with so trifling a production of light, as to be altogether unfit for the purpose of illumination; while the light evolved by the gas of pit-coal was little, if at all, inferior to that from good spermaceti oil; and even after depositing all its condensible matter, yielded a bright and compact flame, though not so splendid as at first.

Experiments were made with coal gas, and other gases, burned in close vessels with oxygen gas, the results of which are inserted in the following table, from whence their composition may be inferred.

	Oxygen gas required to saturate 100 measures	Carbonic acid produced
Pure hydrogen	50 to 54	
Gas from moist charcoal	60	35
——— wood (oak)	54	33
——— dried peat	68	43
——— coal, or cannel	170	100
——— lamp oil	190	124
——— wax	220	137
Pure olifiant gas	284	179

As it is most probable that in the formation of every measure of carbonic acid gas, an equal quantity of oxygen gas is employed, the proportion of the oxygen, which has been consumed by the combustion of the hydrogen of each hydro-carburet, may be known by deducting each number in the third column from its corresponding one in the second. Thus, for example, in the combustion of the gas from coal, 70 parts of oxygen have disappeared, besides what has entered into the carbonic acid; and since each measure of oxygen saturates two of hydrogen gas, the gas of coal must contain in 100 measures a quantity of hydrogen, which, expanded to its usual elasticity in the gaseous state, would occupy 140 measures.

As the quantity of inflammable matter, contained in each gas, is in proportion to the quantity of oxygen required for its saturation, the above experiments shew why the gas from coal evolves so much more light than the hydrogen or hydro-carburet gases during combustion, as it contains about thrice as much inflammable matter as either, according to this mode of calculation.

The light evolved by each gas was also found to be in proportion to the quantity of oxygen consumed by its detonation in a close vessel: And in this manner the olifiant gas, which yields the most splendid light of any, also surpasses every other inflammable gas, in the violence of its detonation, when fired with a mixture of oxygen gas. The specific gravity of the inflammable gases, when freed from carbonic acid, is another test of their fitness as sources of light. Thus the specific gravity of gas, from moist charcoal, is, according to Mr. Cruickshank, 480 (common air being 1000) of the hydro-carburet from alcohol 520, and of the olifiant gas, as determined by the Dutch chemists, 909.

Mr. Henry thinks the pit-coal gas to be chiefly hydro-carburet, with some portion of carbonic oxyd, because it requires somewhat less than the proportion of oxygen to saturate it, which the gas from marshes consumes, and which is always for the latter double its volume, after making allowance for about 20 per cent. of azote, which Mr. Dalton and Mr Cruickshank found to be contained in it, in addition to the hydro-carburet, of which it principally consists. It is fair to presume the coal gas must pre-

viously have contained some oxygen, yielding as it doth an equal bulk of carbonic acid with that from marshes, though it requires a less proportion of oxygen, which, after washing it with lime-water, can subsist in no other state than that of carbonic oxyd.

Gas, from moist charcoal, is probably carbonic oxyd, with hydrogen and a little hydro-carburet; gases, from wood and peat, contain less uncombined inflammable matter, and a greater proportion of carbonic acid, than coal gas; for the two former contain from one-fourth to one-third of their bulk of carbonic acid, and the latter only from one-twenty-seventh to one-thirteenth.

The gases from oil and wax are hydro-carburets mixed with olifiant gas, for on applying one measure of the oxygenated muriatic acid gas, to the same quantity of oil gas, the mixture was reduced to 1¼; a like diminution was produced in the gas from tallow; and that from wax had its bulk still farther contracted, only 1¼ being left by similar proportions; which shewed, from the proportion of olifiant gas, observed to be absorbed by the oxymuriatic gas in previous experiments, that the gases from oil and tallow contain about one-eighth, and that from wax about one-fourth of olifiant gas, the rest being pure hydro-carburet.

Olifiant gas has been proved by Mr. Dalton to be far more absorbible by water than any other species of hydro-carburet, losing no less than an eighth part; and this accounts for the difference of production of carbonic acid obtained from the washed and unwashed gases, observed by Mr. Cruickshank, and of which he could not discover the cause.

The gas from camphor contains much olifiant gas: the hydro-carburets from ether and alcohol also contain it; and this Mr. Henry thinks will also be found to be the fact with all inflammable gases, which, by combustion, give more than their own bulk of carbonic acid.

Mr. Henry thinks that the presence of hydrogen in carbonic oxyd, cannot at present be either affirmed or denied with certainty, and that any hydrogen contained in it is an accidental, and not an essential ingredient; and that, if present at all, it exists in the state of hydrogen gas; which opinion is founded upon the carbonic oxyd not expanding by electrical discharges, which would happen, if it contained carburated hydrogen, either as a constituent part, or accidentally mixed with it.

Mr. Henry explains the combustion in lamps to depend on similar principles to those of the distillation of inflammable matters in close vessels: the capillary tubes formed by the wick serve the same office as a tube placed in a heated furnace, through which an inflammable liquid is transmitted. The fuel, previously melted, is drawn up into these ignited tubes, and there resolved into olifiant and carburated hydrogen gases; and, from their combustion, Mr. Henry thinks the illumination proceeds, and not merely from that of a condensible vapour. Hence, he concludes, that it is probable that the proportion of olifiant gas and hydro-carburet,

obtained by the distillation of any substance, will be a tolerable measure of its fitness for producing light. The degree of heat is, however, of considerable moment in these distillations, as the olifiant gas may be obtained or not, at pleasure, by varying the temperature to which the containing vessels are exposed.

In the gases from coal, peat, and wood, though these substances yield no olifiant gas, the defect is compensated by an inflammable vapour, diffused through them when recent, and which is even not removed by passing them through a small quantity of water. Gas from coal, however, which had stood over water upwards of a month, was found to burn with considerably less brilliancy, though still with a more dense and bright flame than hydrogen gas, or that from charcoal.

In a postscript to this paper, Mr. Henry mentions that he discovered a small proportion of olifiant gas afterwards in pit-coal gas, in another experiment conducted with great caution, and that this proportion amounts to about $\frac{1}{20}$ of olifiant gas.

The postscript also contains an account of the first discovery of the use of pit-coal gas, for the production of light, by Mr. Murdoch, in the year 1792, when he resided at Redruth, in Cornwall, as principal agent and manager of engines in that county for Messrs. Boulton and Watts.

In some of his experiments, Mr. Murdoch found the gas to burn perfectly well, after being conveyed through tubes to the distance of seventy feet. In 1798 he constructed an apparatus at Soho foundry, which was applied during many successive nights to the lighting of the building, when various methods were practised of washing and purifying the air, to get ride of the smoke and smell: and at the rejoicings for the peace in 1802, Soho Factory was illuminated, partly by the new lights, which formed a principal feature in the exhibition.

Mr. Henry also mentions, that at the Coal-Tar Manufactory at Calcutta, in Shropshire, managed on Lord Dundonald's plan, it has been usual for many years past to set fire to the current of gas which flies off, and thus procure a bright illumination.

Observations.—It is to be wished that Mr. Henry had stated the other products obtained by the distillation of pit-coal, as well as those of a gaseous nature, as it is extremely probable that the illumination produced by the inflamed vapour of coal, proceeds from the oil which is driven over from the coal, as well as from the gases; (which oil may be collected by proper refrigeratories, is now an article of commerce, and entirely resembles in its nature oil of turpentine:) and this must happen in every case where proper means are not used to separate the gaseous from the other products; but as this was no doubt done in Mr. Henry's experiments, the results are the more valuable, for as so brilliant a light can be produced by burning the gases alone, all the other products of the distillation may be saved for sale.

Mr. Henry has stated, that the right of priority of invention of this discovery belongs to Mr Murdoch. This is of some importance to those who are willing to dispute the patent-right of Mr. Windsor, to the exclusive use of this improvement, granted him in May 1804; (see the Specification in the Repertory of Arts, New Series) but as the public have been in possession of the discovery long before they ever heard of Mr. Murdoch's claim, (which was first announced by Mr. Henry in the Monthly Magazine last May) they are surely most indebted to those who took the pains to disseminate every where, and make generally known so useful a discovery; and on this ground Mr. Windsor has the first claim to public acknowledgment in this country, who exhibited the invention in the Lyceum in this city, for several months in succession, above a year before Mr. Murdoch's right of priority was heard of, and who has since exhibited it in Bristol, and other parts of the kingdom. Mr. Lardner also, in Piccadilly, has claims to public thanks prior to Mr. Murdoch, for his warehouse near Albany Buildings has been lighted up in the most splendid manner for several months before Mr. Henry's first notice appeared; and as he is the first who set the example of applying the invention to common and profitable use, in a public manner, his claims to acknowledgment are not, perhaps, the least of those mentioned.

The discovery of producing brilliant light from coal-vapour, was made public in France long before Mr. Windsor introduced it in London. Mr. Le Bon had a house fitted up in Paris in the winter of 1802, so as to be entirely illuminated in this manner, which was seen by thousands with admiration; and had a *brevet d'invention* (patent) granted him by the French government, for the art of producing light by the combustion of coal-vapour.

The invention may, however, still be said to be in its infancy. Though promising great advantage, it is as yet applied but in very few instances to any constant profitable purpose. Accounts have been received that it is used to illuminate one of the light-houses near Dublin to great advantage, which, with the instance above mentioned, are the only ones of this kind generally known. Mr. Henry, indeed, mentions its use in Soho manufactory, but his account gives reason to think it was only applied there to temporary purposes.

The great impediment to the use of this method of producing light for domestic purposes, is the very disagreeable smell occasioned by it. At Mr. Windsor's exhibition of it last year in the Lyceum, this smell was so strong as to be easily perceived by those of the dullest olfactory organs, even so much so, as to occasion very disagreeable head-aches to several who were not at all subject to this malady.

To deprive it of this bad effect, seems to be the great point wanting for its perfection; and if any person can accomplish this, he would do a great service to the public by communicating the method; but, even with this defect, it may be used to great

advantage for light-houses, illuminations in the open air, and in all such factories, warehouses, and shops, as can admit of having a draught of air through them. Coal vapour may indeed be burned in glass vessels, placed in any apartment, and communicating alone with the outer air by pipes, to carry off the burned gases, and supply air for cumbustion; and an apparatus for this purpose was exhibited, both by Mr. Windsor and Mr. Le Bon: it may also be burned under glass bells, open at bottom, with a single pipe going from the top of each to the chimney of the apartment; but those methods are rather too expensive and troublesome for common use, particularly the first, and we must still look to the purification of the vapour, in the first instance, before combustion, for the perfection of the process.

It may not be amiss to mention, that Mr. Windsor, both in the specification of his patent, and in other publications on the products of distillation of wood and coal has, in our opinion, made several mistakes, as to their chemical properties, and consequent uses in the arts; and that the great advantage which he (quoting Le Bon as his authority) has asserted coal vapour would have over steam, as a mechanical agent, has not, we believe, more reality than its chemical use in the production of alum, copperas, and vitriol, alluded to above: any vapour, perfectly condensible, as that of water, and to be had without any cost, as to the producing article, must, we presume, be ever superior, as a mechanical agent, to uncondensible gases, the products of articles of value. Mr. Le Bon evidently alluded to the force produced by the explosion of hydrogen gas, burned with oxygen, or common air, which contains the latter; and Mr. Windsor seems to have mistaken this for some application of the vapour of coal meant to supersede the steam engine. There have been patents taken out in this kingdom for the sole use of explosive mixtures, applied in cylinders, to work engines in the same manner as steam; but the extreme danger of such attempts, together with the expense, will probably confine the use of them to the patentees; and Mr. Windsor's idea of the mechanical use of coal vapour will most likely experience the same fate.

Analysis of Goulard's Extract of Lead.

By Dr. Bostock.—*Phil. Jour.* No. 42.

Dr. Bostock having observed the superiority the *aqua litharygyri acetata*, or Goulard's extract, over the acetate of lead, as a coagulator of mucus, was induced to analyse it, to account for this difference, not being able to find any satisfactory description of its composition. Dr. Bostock examined a saturated ssolution of acetate of lead comparatively with Goulard's extract, by

solution of potash, litmus tincture, and other re-agents, by evaporation (to compare their residues), and by their effects on solution of gum arabic; from whence he has constructed the following table:

	100 grs. sol. acet. lead.		100 grs. Goul. extract.	
Lead	15	3	21	0
Acetic acid	7	5	5	0
Oxygen	1	5	2	1
Water	75	7	71	9
	100	0	100	0

From this statement, it appears, that, in Goulard's extract, the oxyd of lead and the acid exist in the proportion to each other of 23 to 5, or 100 to 21,74.

M. Thenard has described the perfect acetate of lead as a salt, in which the oxyd and acid exist in the proportion of 100 to 21,79. So near a coincidence between those two proportions can scarcely be regarded as the mere effect of accident; but must rather be considered as a proof, that the substances operated on were nearly, if not altogether identical. Admitting this to be the case, we must conclude, that Goulard's extract is a saturated solution of the proper acetate of lead, that it is a salt essentially different from the super-acetate of lead, and that it is not, as has been imagined, an accidental compound, but an exactly neutralized salt, the constituents of which exist in a constant ratio to each other.

It happens in this, as in other instances, that the ingredients composing the perfectly saturated solution, possess a weaker affinity for each other than when they exist in a different proportion. To this circumstance may be attributed the superior delicacy which goulard possesses as a test of animal and vegetable mucus, over the common *cerussa acetata*. Goulard's extract is speedily decomposed by the action of the atmosphere, in consequence of the oxyd of lead, which enters into its composition, having a stronger affinity for carbonic than acetic acid; this effect takes place in a less degree, in a saturated solution of super-acetate of lead. From some of Dr. Bostock's experiments, he infers, that the super-acetate of lead is more soluble in water than is generally imagined; as 100 parts of water were, in them, found to retain, in solution, 27 parts of the salt.

Description of a new Apparatus for making the gasiform Oxyd of Carbon, invented by Mr. Baruel.—*Ann. Chem.* Vol. 53.

By an apparatus invented by Mr. Baruel, operator to the chemical lectures of the medical school at Paris, the gasiform oxyd of carbon, which formerly was to be procured only with difficulty,

and in small quantity, by the old apparatus, may now be obtained easily, readily, and at small expense, which affords the advantage of subjecting it to many more experiments than has hitherto been done.

This apparatus may be of use likewise for the preparation of sulphurated hydrogen gas, carbonated hydrogen gas, and phosphorated hydrogen gas. It may likewise be employed for saturating a gas with any substance whatever, particularly when a high temperature is requisite for this saturation.

The apparatus consists of three gun-barrels, placed side by side, horizontally, in a reverberatory furnace, whose extremities pass beyond the sides of the furnace, at both ends; the near end of the first barrel is connected, by a bent glass pipe, with a bottle large enough to hold a sufficient quantity of carbonate of lime, diluted with water; the farther end of the same barrel is joined to the farther end of the second barrel, by a curved tube; and the near end of the second joined, in like manner, to the near end of the third barrel, by another curved tube; by which means, any vapour from the bottle must pass through the first barrel into the second, and, through that, into the third; from the farther extremity of which another tube issues, which is bent at right angles twice, so that its second curvature passes under a receiver on the shelf of a pneumatic water-tub.

When this apparatus is to be used for making gaseous oxyd of carbon, some charcoal is to be taken, very dry, and carefully chosen, broken into small pieces, and introduced into the three gun-barrels: the charcoal is to be pressed lightly together, with an iron rod, so as to occupy only the part of each which is to be heated; but it must not be rammed hard; the three gun-barrels are then to be placed, horisontally, in the furnace, about two inches from each other, secured in their places with moistened brick earth, and covered with the dome of the furnace: the tubes are then to be fixed as before mentioned; and the apparatus being arranged as described, carbonate of lime diluted with water is to be poured into the bottle; and after all the joints of the tubes have been heated with great care, a fire is to be kindled in the furnace; as soon as this fire is sufficiently strong to make the gun-barrels red-hot, sulphuric acid is to be poured into the bottle; which, when it comes into contact with the carbonate of lime, will expel a large quantity of carbonic acid; which, passing through the first barrel into the second, and from that into the third, issues from thence, by the annexed tubes, into the receiver in the pneumatic tub; a funnel, similar to that used in Wolf's apparatus, is directed to be added to the bottle, to facilitate the introduction of the sulphuric acid; but this does not seem to be absolutely necessary.

The object proposed by Mr. Baruel, in this apparatus, was to oblige the carbonic acid to traverse the charcoal contained in the three barrels, and thus to saturate itself with all the charcoal it

could take up. It is true, that in the old method the gas produced might be passed through the single barrel a second and third time; but this mode was tedious, and much of the gas was always lost; but in the new method nothing is lost, and a product is separated at once which possesses all the properties that constitute the gasiform oxyd of carbon, and which may be used unsparingly, as it is always obtainable in large quantity.

Of purifying Silver and Gold by Manganese Oxyd.
By Mr. Thomson, *of Banchory, near Aberdeen.*
Phil. Jour. No. 42.

Mr. Thomson being at a loss for a crucible of silver, for the analysis of some minerals, and considering the best method of effecting his purpose without it, recollected a process of M. Pelletier's, which promised to succeed, and of which Mr. Thomson's is only a little further extension.

M. Pelletier was employed by the French government to discover an easy way of separating the tin from the copper contained in bell-metal; and his process for that purpose was as follows:—Upon the melted bell-metal, project the black manganese oxyd in powder, frequently stirring the metal till all the tin becomes oxydated by the manganese. He gives a caution not to add too much manganese, otherwise part of the copper will be also destroyed.

Mr. Thomson tried this method to separate copper from silver, which it alloys, and found it to succeed completely. He had some impure silver rolled out to about the thickness of a shilling, coiled it up spirally, and put it into a crucible, the bottom of which was covered with black oxyd of manganese. More of the oxyd was then added, till the silver was covered, and all the space filled between the coils entirely. A cover was then luted to the crucible, and a small hole left for the escape of oxygen gas. When this had been exposed for a quarter of an hour to a heat sufficient to melt the silver, the surface of the manganese appeared brown from the loss of oxyd, and where the silver had been, nothing was found but a black powder. The whole contents of the first crucible were then put into a second of a larger size, in the bottom of which was placed a quantity of pounded green glass, about three times the bulk of the contents of the first crucible, and a cover was luted on as before, to prevent the access of any inflammable substance.

The crucible was then exposed to a heat sufficient to melt the glass very fluid. Upon cooling and breaking the crucible, the silver was found perfectly pure, as its oxyd alone, of those in the

crucible, could part with its oxygen without the access of some inflammable substance.

Mr. Thomson found this method to answer equally well for the purification of gold, and thinks it better than the former methods, as the materials are cheap, and a large quantity can be refined as soon as a small quantity, by using more capacious crucibles.

Mr. Thomson tried the process with gold and silver in round masses, but it went on so very slowly as to convince him of the necessity of previous lamination of the metals. He also found that the metal remained impure, until after it was totally reduced to the oxyd or black powder.

Mr. Thomson mentions that he would not have published the account of this matter, until he had made experiments to determine the exact proportions of the alloy, manganese, and glass, to be generally used in this process, and also to ascertain if there is any truth in the old opinion, that nitre, melted with gold, destroys a part of it, (which he supposes may be caused by the nitre oxyding the copper in alloy with the gold) and thereby have been enabled to bring the matter before the public in a more perfect form, if some person, to whom he mentioned it, had not sent an account of it for publication to a periodical work without his knowledge; and mentions Mr. Kirwan's having known, long ago, his being the discoverer of this process.

Observations.—Dr. Wm. Dyce, of Aberdeen, has published an account of a process in all respects similar to that of Mr. Thomson's, in the Transactions of the Society of Arts, which may be found detailed in our first number. Whether Dr. Dyce is the person to whom Mr. Thomson means to allude, is impossible for us to say: and it is also as difficult to decide, to which gentleman belongs the honour of having first used the particular application of the process to the refining of silver and gold; for as to the process itself, the discovery of it is certainly, in our opinion, due to neither of them, but to M. Pelletier.

The determination of the right of priority of invention concerns the public only so far as the honour and estimation which being the author of any useful discovery confers on any man, induces others to devote their talents to similar pursuits, by which more discoveries may be made: for as to the mere benefit which mankind may derive from any particular discovery, considered solely by itself, they are certainly, at least, as much indebted to the person who first publishes the invention, as to the person who first makes it, and in some cases even more: for it is the person who brings forward a useful matter to notice, makes individuals thoroughly understand its value, and, in a manner, compels the public use of it, that is the immediate cause of that benefit, which might otherwise have been buried with its author, who, whatever might be his motive for not publishing it, from that

very circumstance alone can claim no consideration from the public. It appears, however, in the present case, that Mr. Thomson fully intended to publish the matter in due time; and if he used this process before Dr. Dyce, we can only lament with him that the Doctor got the start of him in the contest of priority by some months at least of previous publication.

In another paper, in the same number of the work from whence the foregoing was extracted, in answer to some queries respecting the best method of purifying copper, to make it fit for alloying gold, and other nicer purposes, Mr. Nicholson recommends the method herein recited, directed first by M. Pelletier, as being likely to succeed, "if due attention be paid to the manipulation and proportion of manganese to be made use of:" as well for the general purification of this metal from other alloys, as from the particular one of tin, for which it was first devised.

Action of Phosphorus on the Solution of Metals.

By M. SCHNAUBERT.——*Jour. Chem. Vol.* vi.

THE precipitation of metals by phosphorus had been observed by others before M. Schnaubert. M. Sage had observed that effect of it on the sulphates of copper and manganese; after him, Ilseman obtained a crystallization of silver by phosphorus. Madame Fulhame since that published experiments on the reduction of some metals by phosphorus dissolved in ether. Mr. Schnaubert's experiments are the most recent on this subject, and produced the following results.

Gold.

Two little bits of phosphorus were put into a nitro-muriatic solution of gold, diluted with a small portion of water. At the expiration of twenty-four hours the solution was completely colourless, and pellicles of the colour of metallic gold swam on the surface of the liquid. The phosphorus itself was covered with a deep brown coating, and in this was observed, in several places, thin layers of reduced gold. At the place where the phosphorus was, a black circle was perceived. The solution thus treated by phosphorus had not a single atom of gold left in it.

Silver.

Some phosphorus, left for twenty-four hours in a nitric solution of silver, diluted by water, was completely covered with metallic silver in the form of dendrites, the ramifications of which were directed upwards. During ebullition, this remarkable crystallization of silver, which made the phosphorus appear as if garnished with points, assumed first a white colour, and afterwards formed a light black mass, which at length became of a light brown colour.

Quicksilver.

Mercury dissolved in nitric acid is precipitated on the phosphorus in the form of little metallic globules, which cover it entirely. By heating to ebullition, the mercurial globules disappear, and a black mass, without any metallic lustre, is formed.

Lead.

At the ordinary temperature, phosphorus did not act on the nitric solution of lead, though the digestion was continued for several days; at a boiling heat, however, a change was observed in the phosphorus, which was covered with a grey colour, slightly metallic.

Copper.

No metallic solution was more strongly attacked by phosphorus than that of copper in nitric acid. The phosphorus was no sooner introduced into the solution of copper, than it assumed a black colour. In twenty-four hours it was covered with a stratum of very thin layers of copper, and the solution had become much paler. The application of heat caused drops of phosphorus to flow out upon the reduced copper, where they immediately assumed a black colour. These drops, after a time, were covered in their turn with a metallic coat of copper. After this the solution was perfectly colourless, and ammonia did not detect in it the least particle of metal.

Tin.

Several bits of phosphorus were put into a solution of tin in nitro-mutiatic acid. The next day the phosphorus was coloured of a deep brown, only in some parts a metallic colour was observable. These metallic spots disappeared on boiling, and the phosphorus became still deeper coloured.

Manganese.

Some bits of phosphorus were put into a solution of manganese in sulphuric acid. The next day the phosphorus was of a deep brown colour, and on its surface was perceivable a pleasing mixture of colours, owing to the reduced metal. The mixture was then heated to ebullition; and, after it had grown cold, the manganese was found reduced in the form of little radiating lines on the fused phosphorus, intermixed with a few small globules of the white colour of tin.

In these experiments may be observed, that the phosphorus, besides disoxyding the metals united with them, also to form phosphurets, as was evident in the solutions of silver, mercury, and tin.

M. Van Mons adds to these experiments of M. Schnaubert's the following very curious one of his own:—

In making this experiment with a solution of sulphate of copper, and slightly heating the mixture, at first a vapour arises, consisting of phosphoric gas, that carries off with it some small particles of phosphorus, which takes fire on the surface of the solution; but the extrication of this vapour soon ceases, and the phos-

phorus becomes hermetically enclosed in a case of copper, in which it is defended from any farther action of the sulphate of copper, and even of the air, to whatever temperature it be afterwards exposed, short of fusing the copper. The plate of copper that forms this covering is two or three lines thick. It possesses more tenacity than common copper, for it may be flattened with a hammer in different directions without cracking, which at the same time proves the great compressibility of the phosphorus, and it shines with a very pure metallic lustre. On opening the case carefully with a cutting instrument, the phosphorus is found in it, retaining perfectly its form, filling its copper case completely, and not appearing even to have acted on the sulphate.

Several other metals were tried, without producing the same effect, no doubt on account of their containing more oxygen.

Observation.—Where pure copper is wanted for very nice purposes, such as alloying gold for jewellers' use, it is very likely that this last method of obtaining it might not be too expensive. The copper thus procured seems, from the above account, to be of a remarkable fine quality, and is most probably proportionally pure.

On Nickel entirely pure: proving that it should be ranked among the noble Metals, and on its Preparation and Properties.

By Dr. J. B. Richter.—*Ann. Chem.* Vol. 53.

There is no certainty that the triple salt, which results from the combination of nikel ammoniac and sulphuric acid, is entirely deprived of a mixture of cobalt, even after being many times dissolved and crystallized, although, by this operation, the cobalt may be reduced to a very small quantity. But when every trace of cobalt is made to disappear, the copper still remaining presents a new obstacle to the preparation of nickel absolutely pure. I have before observed, in another memoir, that cobalt may be deprived of all its copper by subjecting it to a sublimation with muriate of ammonia; but at that time I had not yet obtained the regulus of nickel perfectly pure, as the following experiments demonstrate.

In the complete purification it always separates from itself more or less copper, from whence may be concluded, that the sublimation with sal ammoniac has not driven off all the copper of the cobalt which the nickel contains, although the volatilized ammonia does not exhibit any traces of copper. This triple salt also contains some particles of arsenic: it may likewise still retain some iron, especially when the nitre has been too sparingly used, with which the sulphuric acid has been mixed to dissolve the ores of cobalt which contain the nickel, after they are roasted.

All my endeavours to purify this metal completely in the wet way were in vain. I decomposed then the triple salt, (which was deprived of its iron, and contained but a very minute portion of cobalt), by carbonate of potash, and endeavoured to avoid the loss of the oxyd of nickel, by not adding too much of the carbonate of potash. The precipitate had always a blueish green colour. It was abundantly edulcorated, dried, and urged by the fire. During this last operation it changed its colour, because it lost its carbonic acid; it now assumed a blackish grey colour, still preserving a small tint of green, instead of its former shade. That the metal might not be lost which the water contained, that had been used in washing the precipitate, which was of a green colour, and transparent, it was evaporated to dryness. The green residue was urged by the fire, and made frequently to boil with different portions of water, to which it did not communicate any colour. The residue was almost entirely composed of carbonate of nickel, in the form of a green powder, which, urged again in the fire, did not alter its colour.

Each of these two kinds of oxyd of nickel were mixed with a fifth of its weight of charcoal, and exposed for eighteen hours to the fire of a porcelain furnace, in an essay crucible covered with a little porcelain enamel. The products of this operation were a little different; both bore some strokes of the hammer before they broke, but that which proceeded from the green oxyd, (which was produced by urging in the fire the salt which still contained nickel), was more white and more brittle than that which came from the oxyd, made by the precipitation of the triple salt by potash. This last was farther distinguished by its colour, which was somewhat like that of steel, and which was a little redish. Both dissolved quickly in nitric acid, and were attracted by the magnet; but that which was white and brittle, was the least attracted.

Many appearances which I had observed in experiments with porcelain, had almost convinced me that nickel was a perfect metal, of which the oxyd might be reduced by a proper degree of heat, without the addition of a combustible body.

I dissolved in pure nitric acid all the metal of nickel which I had made, and which amounted to many ounces, and I evaporated this solution to dryness; the solution took place very rapidly, and grew very hot, although the acid was only of a moderate strength. The dried mass dissolved in water with a beautiful green colour, but there remained a small greenish white residue, which was iron nickel and arsenic acid mixed.

I decomposed this nitrate of nikel, which contained still a good deal of copper, by the carbonate of potash. I urged with the fire the carbonated metal, which had a lively green colour, but which was not so bright as that of carbonate of copper. This colour changed in this operation into a very deep green, with a slight shade of grey and brown; exposed to a still more violent fire, the green and brown colour became deeper than before; at

the same time the matter joined together in a mass, and some little metallic particles appeared interspersed through it. As I had not an opportunity of fusing the matter in a reverberatory furnace, I distributed it in several crucibles, and put them in a porcelain furnace in that part where the fire was so violent, that the most refractory crucibles were destroyed.

The fire of the porcelain furnace, which commonly is kept up for eighteen hours, did not act in the same manner on all the crucibles. Those which were placed at that part of the furnace where the heat operates more gently in baking the porcelain, were scarcely changed, and the matter was in them only united together in a mass. In other places the matter had become liquid, but the crucibles were likewise fused at the same time. After having broken them, I found in the fused mass morsels of metal of different sizes, and in form of kidneys. The greatest were equal in size to nuts, and the least to grains of millet; their metallic lustre held a middle place between that of tin and of silver. The scoriæ were of a greenish brown, and nearly of an amythist colour, and in many places were of a deep blue, as the fused oxyd of cobalt generally is. The brown colour was caused by the oxyd of copper, which was entirely vitrified; the blue by the oxyd of cobalt, and the green by the arseniate of nickel, which obstinately resists reduction, without the addition of a combustible body. I tried the metallic grains on the anvil, and remarked, with great pleasure, that they had a great degree of ductility. The magnet strongly attracted them.

As it was impossible to separate individually all the little particles of metal, I reduced the matter from the crucibles to powder, and washed it; then I distributed the metal, which I had collected in these operations, into several small crucibles, and placed them again in the porcelain furnace, in the hope of obtaining the metal in larger masses to forge into rods. The fire again acted on the crucibles in as unequal a manner as on the first occasion. In many of the crucibles there was a single large bit of the metal perfectly fused; but in those which were in the cooler part of the furnace, I found the particles only cemented to each other; and they were not fused, till they were exposed to the fire in a hotter part of the furnace.

As the preceding experiments had convinced me, after being many times repeated, that the oxyd of nickel may be reduced to a metal without the addition of any combustible substance, I made a trial with an oxyd of this metal, that I had not taken from the impure metal named farther back (which was reduced by means of a combustible body) but which I obtained by the decomposition of the triple salt, which I have frequently mentioned, and of which I had amassed a considerable quantity from operations continued incessantly during a year and half. The results of this experiment were also very various; many of the crucibles contained a single morsel of nickel, with a scoria that was entirely

fused, and of a deep brown colour, which had a shade of green and of amethyst colour, and some spots of blue. The other crucibles only contained some kidney-shaped particles of nickel, dispersed among the scoriæ, which were only fused into a sort of pulpy state. The crucibles which were placed in the cooler part of the furnace contained only a matter connected in a mass, which exhibited here and there little metallic particles.

I once more exposed to the fire in the porcelain furnace those two last-mentioned products. The result was the same as in the former experiments. I found in some of the crucibles a single lump of nickel separate from the scoriæ, and in others small kidney-shaped bits mixed with the scoriæ. With these last I repeated the operation, until I perceived, by the perfect liquefaction, that there was no more metal in the scoriæ. At last, the scoriæ in some of the crucibles became so liquid, that the bottoms of the crucibles were penetrated, and the metallic nickel ran through into the cavities of the support. The largest lump of metallic nickel, which was produced by fusing many smaller bits together, was only an ounce and half in weight. It was found in a part of the furnace where the fire had destroyed all the other crucibles, and it was fortunate that the crucible which contained it, was very strong at the bottom, for I remarked in it the commencement of a liquefaction, which had almost penetrated through it.

To save the trouble of fusing the same materials so often, I mixed my oxyd of nickel with equal parts of porcelain enamel; but I obtained still less advantage by this method, for a considerable quantity of the nickel formed with the enamel a mass of a very dark greenish brown colour, which had been liquid; and even the separation of the nickel into detached particles was not by this means prevented. This experiment succeeded better when I only covered the oxyd of nickel, which was intended to be reduced *per se*, with a little enamel, after having put it into the crucible. But the best method is always to expose to the fire, without addition, the oxyd of nickel, which has been purified in the wet way as much as possible.

I at last succeeded in procuring several ounces of this metal, which may be considered perfectly pure nickel, but which cost me much time, patience, and expence; therefore I can only partly at present explain its particular properties, and shall be able hereafter to do so in a better manner.

I shall begin with the description of nickel in an absolutely pure state.

A. The colour of this metal is a medium between that of silver and of pure tin.

B. It is not subject to be altered by the operation of the air, or atmospheric moisture; that is to say, it is not liable to rust.

C. It is perfectly ductile. Rods may be forged from it when it is red hot; and very thin plates may be also drawn out from it on the anvil in a cold state. By this quality, nickel is entirely

separated from the class of semi-metals, and entitled to take its place among the perfect metals.

D. Its specific gravity is very considerable. After many times weighing it in my hydrostatic balance, I found the specific gravity of the fused nickel 8,279, and of the forged nickel 8,666.

E. The tenacity of this metal seems also very considerable. I beat a piece of it out on an anvil between folds of paper, (after having annealed it, by making it red hot, and letting it cool gently), and which piece weighed five drachms,) into a plate of thirteen inches square surface; by which it is evident that nickel may be drawn into plates of 0,10 of an inch in thickness. I conclude from this, that it might also be drawn into wire of the same diameter.

F. Nickel is extremely difficult to fuse, at least as much so as manganese. On this point no exact experiments can be made, even by putting two crucibles in the same fire; for I have found a difference, in making trial, of the degree of fusibility of morsels of nickel, and every other metal. The result depends much on the point where the flame is directed, and this is extremely variable.

G. The oxyd of this metal becomes reduced at a temperature sufficiently raised, without the addition of a combustible body. It is only its property of fusing with such difficulty that occasions the trouble of this reduction, which at the same time purifies it. There is but little tendency to oxydation in this metal perceived; in making it red hot, it only becomes a little more dull than platina, gold, or silver; therefore nickel belongs not only to the class of perfect metals, but to that of noble metals.

H The effect of the magnet on nickel is not only very great, and but little inferior to that on iron; but moreover this metal becomes magnetic, and acquires polarity by friction with the loadstone; or, if the circumstances are favourable, by blows of the hammer, or by filing it. In this state it not only attracts iron, but also other pieces of nickel of some size, and causes them to move at a considerable distance on a smooth table.

I. Nickel preserves its magnetic properties, even after being alloyed with copper, provided the copper is not in too great a proportion. But arsenic truly deserves the name of the destroyer of magnetism in this metal, as I often experienced. It also injures its ductility, for which reason it ought to be carefully separated from it.

K. Sulphuric acid, or muriatic acid, acts but little on nickel. I used the latter for cleaning its surface, when it had lost its beautiful metallic lustre by the fire, or by the strokes of the hammer; for this purpose I boiled it in the acid, which notwithstanding dissolved but very little of it. The best solvents of it are the nitric acid, and the nitro-muriatic.

I observed before, that nitric acid dissolves nickel in its impure state (especially when it contains any copper) with rapidity and

heat. This acid acts somewhat differently on nickel entirely pure, especially when it has been hammered. I put some grains and plates of nickel in pure nitric acid, expecting that they would be rapidly attacked; but the solution was so slow, that I was obliged to use the heat of a spirit lamp to hasten it. I decanted the liquor after it had dissolved a very small quantity, and I added some of the same acid as the first, when suddenly the solution took place so rapidly, and with so much heat, that I was obliged to carry the porcelain vessel, which held it, with all possible speed under the chimney of the laboratory, to give free passage to the vapours.

I shall now notice some other properties of nickel, after it has lost its metallic state.

A. The solution of nickel in nitric acid has a beautiful green colour. When it is decomposed by carbonate of potash, a precipitate of a clear apple green is deposited. This precipitate washed and dried it very light: its absolute weight is to that of the nickel employed as 2927 to 1000.

B. When the carbonate of nickel is exposed to a red heat, its green colour changes to a blackish grey, with a very slight hue of green; and there is, at the same time, a considerable loss of weight.

The oxyd, before being heated, weighs 1285, if the metal weighs 1000; and in urging the fire, it approaches more and more to the metallic state, and the little black and grey particles are attracted by the magnet. This happens more quickly, if the oxyd of nickel is moistened with a little oil before increasing the fire.

If pure ammonia in excess be added to a solution of nickel, a colour is produced resembling ammoniacal copper, but it changes sometimes in less than two hours to an amethyst red or violet; in adding an acid, this violet colour changes to a green, but by the addition of ammonia this colour becomes white, and changes as before.

If a quantity of a solution of copper be added to a solution of nickel, which does not sensibly change its tint, the blue colour produced by adding ammonia no longer alters; also if a little ammoniacal copper or ammoniacal nickel be added when it is of an amethyst red, this latter colour disappears directly. It follows from this, that a nitric solution of nickel, to which ammonia is added, is not pure when it becomes white; and as hitherto no ammoniacal solution of nickel of an amethyst red has been produced, it is certain that the nickel combined with the ammonia always contained copper.

In concluding this paper, M. Richter announces his intention of making more experiments on this metal; and that, to farther the experiments of others on the same subject, he is willing to dispose of metallic nickel in small quantities, at the rate of twelve livres per gross or drachm, that is, four pounds sterling per ounce.

Observations.—The very valuable qualities which Mr. Richter has discovered in this metal, shew that it would be extremely useful in the arts, if it could be procured at any reasonable rate. It resembles platina in many of its properties; and it is therefore probable that the methods contrived for separating and working up platina would also be applicable to nickel. If it could be brought to a proper hardness, its not being liable to rust would make it a valuable substance for forming cutting instruments of all kinds, but particularly surgical instruments, in which the corrosion is frequently so very speedy, when they are made of steel, as to cause them to be sensibly altered by a single operation.

Nickel, from its attractability by the magnet and polarity, might be used to form needles for compasses, which, not being liable to rust, would preserve their virtue better than those of steel, which suffer considerable injury from this circumstance.

This quality of nickel naturally induces a suspicion that it may in the end prove to be an alloy of iron, with some other substances; if this should be discovered to be the case, and through it the means of giving to iron such valuable properties as nickel possesses, it would be a most important discovery.

The great heat which nickel requires for fusion, and its great specific gravity, suggest a method for separating the small grains of it from the scoriæ, in a mixed state, with which it is produced in some of the operations mentioned before; which method is easily tried, and if it does not succeed can occasion no great trouble, but if it does may lead the way to other processes of considerable use. This method is, to throw the scoriæ containing the granulated nickel, after being reduced to a powder, into a quantity of tin in fusion; the nickel, it is imagined, by this means, would fall to the bottom of the tin, from being heavier than it, and the scoriæ would float at the surface, from whence they might be easily removed. The nickel, in grains, might afterwards be separated from the fused tin, by pouring it through a heated very close sieve of copper or iron wire; the small heat which the tin requires for fusion would probably not affect the nickel while remaining in it, as the latter requires so very great a heat for the same purpose. The nickel might be easily cleared from any tin that might adhere to it in the operation, by infusion in marine acid, which has a strong action on tin, and very little on nickel.

It is probable that a reverberatory furnace would be the best for the reduction of nickel.

An Account of the Memoir of Messrs. HUMBOLDT *and* GAY LUSSAC *on Eudiometers, and the constituent Principles of the Atmosphere, given to the French National Institute by M.M.* CHAPTAL *and* BERTHOLLET.—*Ann. Chem.* Vol. 53.

ALL the different species of eudiometers yet known would give the same results, if their natures were equally well understood; and although nitrous gas appears the most uncertain, yet Messrs. Humboldt and Gay Lussac are sure that in combining its action with that of sulphate of potash, or of muriatic acid and potash, they can indicate with great precision the quantity of oxygen contained in the atmosphere; and it is only because it is very difficult to make all the necessary corrections, that the means which require the least of them are naturally preferred.

The authors confine themselves here to the examination and comparison of two eudiometers, the alkaline suphuret, and the combustion of hydrogen gas, in the apparatus of Volta.

The alkaline sulphurets had obtained the preference over the other eudiometers in the opinion of most chemists; but M. Marti has observed, that while they are fresh they absorb azotic gas. The authors of this memoir have made it apparent that the difference of these results depends on the nature of the solution of the sulphuret; if this solution be made by heat, there is more or less azotic gas disengaged from the water; and moreover, the water may dissolve a proportionate quantity, so that it may make in the azotes of the air, submitted to examination, a diminution which varies according to the relation of the liquid to this gas; but it is to the water alone, and not to the action of the sulphuret, that this absorption must be attributed.

In avoiding this cause of error, confidence may still be placed in the alkaline sulphurets as eudiometers. But the authors give the preference to the eudiometers of Volta, for the following reasons:

They consider this eudiometer both with regard to its advantages for eudiometrical proofs, and the phenomena which the combustion of hydrogen and oxygen gases present.

To determine whether the absorption of one of the gases is complete, when a mixture of hydrogen and oxygen gases are burned in the eudiometer of Volta; they formed different mixtures of the two gases, making each respectively exceed the other in different proportions; and they observed that the absorption which results from the combination that it produced, is constant to a certain point, when it suddenly diminishes rapidly, till at last combustion will not take place; so that one hundred parts of the hydrogen gas mixed with 200 or 900 of oxygen gas, give equally an absorption of 146 parts; but with 950 parts the absorption is only 68, and

it decreases rapidly with every increased proportion to that of 1600, when it ceases entirely.

When the hydrogen is made to predominate, the same occurrence takes place; it only happens that the point at which the absorption ceases is more remote, because that in this case, the part which loses the gaseous state, is double that which disappears when the oxygen gas is in the greater proportion.

The authors have carefully proved that the part which has been absorbed during the combustion, is found exactly in the residue.

The mixtures of other gases, such as azote and carbonic acid gas, occasioned no sensible difference in the influence of the above proportions; however, the authors propose to determine this point hereafter with greater precision.

An important consequence of these first observations is, that the absorption of the oxygen and hydrogen is complete in the proportions mentioned, and not being so in other proportions, it is always possible when a gaseous mixture is given, which only must not be capable of inflammation, to reduce it to another, in which the absorption of one of the gases shall be total, by adding to it oxygen or hydrogen, or even both together.

The limits of the combustion, which ceased to take place with certain proportions of the gases, led the authors to some general considerations of great importance, on the cause of the combination which is formed by combustion, and on that of many meteoric phenomena.

They have proved that the immediate cause of the combination of oxygen with hydrogen cannot be owing to a compression which forces together the particles, as has been supposed, since in raising gradually a mixture of oxygen and hydrogen gases, with the precautions necessary to avoid all obstacles to their dilation, the inflammation took place equally well.

However, too much extension should not be given to the consequences of this observation. In the fulmination of gold and silver, and the detonation of many other mixtures (which only need a blow, or a very moderate compression, to produce a combination of the oxygen with the hydrogen, or other bases), it is difficult not to attribute this combination to the compression which tends to force together the particles. In attributing the whole effect to the elevation of temperature, a risk is run of excluding a cause which might also produce it, and which may contribute to the combination of the hydrogen with the oxygen, though it could not determine the incipient inflammation.

And also this proposition of others: "*That all combustible bodies in general require a certain elevation of temperature for their combustion with oxygen,*" appears to the authors to possess a generality which would have much obscurity in its application; carbonic acid is formed by the action of atmospheric air, and consequently there is a real combustion at temperatures far remote from that necessary for the combustion of condensed charcoal.

Moreover, one degree of elevated temperature produces sometimes a combination which another degree destroys; thus ammoniac and nitric acid are formed at an elevated temperature, but a temperature raised still higher destroys the combination of their elements.

The authors confine the explanation of the effect of electricity in the inflammation of oxygen and hydrogen gases, to the opinion that they combine on account of the inflammation: they think then that the electric spark only causes inflammation, because by a momentary compression it raises the temperature of the gases to the necessary degree.

The explanation of the authors here leans entirely on the compression and close junction of the particles, of which they neglect the immediate effect on the affinity of the particles; neither can the double effect of the decomposition and composition of water, which takes place by different degrees of electric action (as the Dutch chemists, Sylvester and Chappe, and more lately Mr. Tenant, of England, have shewn) be thus accounted for.

The authors have made interesting observations on the quantity of hydrogen which may be supposed to be in the atmosphere, and on the effects which electricity can have on it.

They have made it evident that at least six hundredth parts of hydrogen must be in the atmosphere, for the electric spark to cause any sensible inflammation; but their experiments, by which they were able to detect even three thousand parts of hydrogen gas, did not shew the least sign of the existence of this gas, even in air taken at the greatest heights to which men have ever raised themselves. They thence conclude, that if the atmosphere contains any hydrogen it must be a quantity less than a three thousandth part, a quantity entirely insufficient for the explanation of those meteoric phenomena, which some have supposed to be the cause of the instantaneous production of large quantities of water

But the observations made on the air in its ordinary state, cannot in strictness be applied to it, when contained in clouds, or porous vapours in the time of a thunder-storm; many meteoric phenomena depend probably on certain undetermined causes, of which it would not be right to exclude any but after a succession of observations which we are still without, and which we ought to hope for from the activity of the authors of this memoir, who have proposed to make this object their peculiar study.

The second question, the determination of which occupied the authors, was, whether the product of the combination of oxygen and hydrogen gases was of a constant nature.

On this point they made a great number of experiments, by putting reciprocally the oxygen and hydrogen in excess, and they obtained constantly the same proportions of each gas from the absorption which was made of them: they thence infer, that the result of the combustion of hydrogen gas is uniform, and that there

is no such thing as oxygenated or hydrogenated water. But what are the precise proportions which compose water? this forms the third question which the authors proposed to themselves.

They proved by many experiments made with inverse proportions, that one hundred parts in quantity of oxygen gas require almost two hundred of hydrogen to saturate them. According to the experiments of Fourcroy, Vauquelin, and Seguin, which are the most exact that have been made on the composition of water, one hundred parts of oxygen require one hundred and five of hydrogen; but they remark, that in adopting either proportion there may be an error of a 0,035 part, in the absolute quantity of the oxygen of the air; and that when relative quantities only are to be determined the error is much less.

They have determined in these experiments, the quantity of azote which was mixed with the oxygen gas or the hydrogen gas which they used; and have proved, that these two gases, prepared with all the care which can possibly be bestowed on them, shall the first contain a 0,04, and the second a 0,06 of azotic gas, a difference of which no doubt they will endeavour to discover the cause.

They have made an important observation on the valuation of the elements of water by the weight or the quantity, or measure.

It has been remarked that the difference of the temperature might cause considerable alteration in the valuation of very light gaseous substances by weight, and particularly of hydrogen gas, by the proportion of water which might remain dissolved in them by the heat. The authors observe that hydrogen at fourteen degrees of Reaumur's thermometer (which is the same degree as that at which Fourcroy, Vauquelin, and Seguin, made their experiments) may contain a sufficient quantity of water to change the proportion established by weight of 85,662 of oxygen, to 14,338 of hydrogen, into that of 87,41 to 12,59; on the contrary, the proportions as determined by measure remain always the same, notwithstanding the changes of temperature and humidity, provided that each of the two gases experience the same circumstances.

They have remarked, that this eudiometer affords not only results easily compared, but that it has the advantage of not requiring any correction of temperature, and have made it evident that the quantity of oxygen may be determined, when it is less than a three thousandth part, by adding a determined quantity of the same gas to the mixture; and that it serves equally well for ascertaining the smallest quantity of hydrogen gas mixed with another gas: they have confirmed these facts by experiments on the factitious airs, and have concluded from all these researches, that Volta's eudiometer is the most exact and the most valuable for the analysis of gases.

The authors in the next place proceed to the examination of atmospheric air. They have proved that there exists in it a pro-

portion of twenty-one parts of oxygen to seventy-nine of azote, which is agreeable to Mr. Davy's determination: that atmospheric air does not vary in its composition more than a thousandth part of the quantity of oxygen, and that if it contains any hydrogen, it is less than a three thousandth part; that the air of a crowded theatre altered by the breathing of a great number of people, experiences so very slight an alteration in its proportion of oxygen, that its insalubrity cannot be accounted for from this cause, and thus confirms on this point the observations formerly made by Cavendish, Priestly, and Seguin.

The second part of the memoir relates to experiments made on the nature of air extracted from water, and of the action which water exercises on the gases, both pure and mixed.

It is known that water holds air in solution, that the air contained in water is more pure than atmospheric air, and that this last, held in contact with water, yields to it a portion of its oxygen, so that it is by this means vitiated.

The result of the experiments of the authors is, that distilled water, rain water, and water of the Seine, yield an air nearly equally rich in oxygen, and ten hundredth parts more pure than atmospheric air: this quantity is more variable in well water. If water be gradually heated, and the air that is separated from it be divided into different portions, the proportion of the oxygen goes on increasing as the point of ebullition is approached, so that it appears from this, that water has a stronger action on oxygen than azote.

Water charged with muriate of soda does not yield but about half the air obtained from fresh water of the Seine, but this half contains a greater proportion of oxygen. This difference happens, because half of the air, which is naturally contained in water, is disengaged during the solution of the salt, and that this first half contains a greater proportion of azote.

In like manner ice loses by congelation a part of the air, which contains a greater proportion of azote, and there is obtained from it then a smaller quantity of air, but which is more rich in oxygen: thus these three correlative results prove equally the greater action which water exercises on oxygen than on azote.

However, snow contains a greater quantity of air than ice, a difference which depends on the circumstances of its formation.

In examining the action of water on gases placed in contact with it, the authors observe,

That of oxygen, hydrogen, and azote, oxygen is the most absorbed by water of the Seine, and that its real absorption is even greater than what is apparent, since they discovered by analysis, that the remaining gas contained a much greater proportion of azote, than what was in the gas first placed in contact with the water.

The volume of the azote, put in contact with water, diminished very little; but on its part it separated from the water a portion of

the oxygen gas, which is held in solution, though the effect was less than in the preceding case.

This fine experiment shews how necessary attention is to every circumstance in such experiments, for great changes may thus take place without shewing any apparent sign, if exact analysis be not used. This observation is followed by another no less important: water has scarce any action on hydrogen gas; but if the the hydrogen is mixed with oxygen gas, the water then not only absorbs more oxygen than if it was alone, but it absorbs also at the same time a considerable quantity of hydrogen gas; and, moreover, separates from itself a portion of azote.

The hydrogen gas which was absorbed, is again separated from the water by ebullition; but the authors propose to examine more particularly if a part of it does not become intimately combined with the oxygen, at least by the aid of time.

The authors thus express themselves in considering the cause of the solution of air in water:

"The experiments which we have made on the force with "which the last particles of air are retained by water make more "manifest the state in which air exists in liquids. Distilled water, "and that charged with air, having, to all appearance, the same "specific gravity, Mairon has concluded with reason, that air "cannot be lodged in fluids in an elastic state, and our experi-"ments support this opinion. If water deprived of its air by "distillation, or by the air pump, may be considered as a sponge, "the pores of which are empty, how then should not these pores "fill themselves on the first contact with atmospheric air? But "this solution of air in water can be considered only as the "effect of a chemical affinity, for how else, but by this affinity, "could the absorption of the gas by the water deprived of air be "so slow? and, above all, how else should the water dissolve one "gas in preference to another? and how should the water "charged with one species of air abandon a part of it, to receive "another of so different a kind."

These considerations leave us no doubt of the action of affinity in the solution of gases by water; though the contrary opinion, sustained by Mr. Dalton, is adopted by Mr. Henry, whose experiments on this subject are not to be relied on, because he did not examine chemically the nature of the residuary gases; and as to the circumstance of water absorbing by compression at the same temperature a greater quantity of gas in proportion, than without it, on which he rests his opinion of the mechanical action of water on the gases, some of his own observations tend to prove the contrary, (that absorption is not in proportion to the compression) for he found that one hundred cubic inches of water, at fifty-five degrees heat of Fahrenheit's thermometer absorbed a hundred and eight of carbonic acid gas, as well as of sulphurated hydrogen; so that the natural volume of the gas ought not only to find a space equal to that which it occupied, but also experience some causes of

compression greater than that of the atmosphere, to produce this effect.

Since elasticity is an obstacle to the action of affinity, which ought to exist between water and the gases, it appears natural to us that the solution should be proportionate to the cause which diminishes this elasticity, or to the compression which the gas experiences.

If this explanation be not satisfactory, there is still no reason to reject the action of affinity in this case, which is attested by so many other effects; and this reflection ought to apply to many other cases, where the coincidence of chemical and physical properties might cause the action of affinity to be overlooked, if the causes of a phenomenon were judged of without considering the analogies by which they are united to other phenomena.

It cannot be too often repeated, that the progress of science can alone be assured, by giving the greatest precision to experiments, and advancing the perfection of the methods by which knowledge is gained. If this exactness be wanting, we have only in its stead a collection of incoherent facts, on which are established various systems in succession, and opinions that contradict each other.

The Memoir of Messrs. Humboldt and Gay Lussac has not only the advantage of this exactness in an analysis important to chemical science, but also contains a series of new and interesting facts.

Analysis of the Obsidian of Mexico, brought over by M. Humboldt.—*By M.* C. Descostils.—*Ann. Chem.* Vol. 59.

M. Descostils having made two experiments of analysis of this stone, in each of which there was a loss of about thirteen in a hundred parts, and the produce was silex, alumine, iron, and manganese oxyds, a third time undertook the business, in order to discover the nature of the parts unaccounted for in the former trials.

He put about eighty grains of obsidian into a platina crucible with sulphuric acid, and boiled it three hours, adding a little acid from time to time; he then put to it a little water, and filtered it. This liquor was evaporated. The residue was again dissolved; ammonia added to it, filtered, and evaporated to dryness; the produce was then put in a platina crucible, and heated till it ceased to disengage vapours. There remained behind an alkaline salt, which was put aside.

The part which was not attacked by the sulphuric acid, was heated at an obscure red heat for two hours in a platina crucible, into which, in two separate portions, was introduced caustic po-

rytes. Before heating, a little water was added to dissolve a part of the barytes, that it might mix the better with the residue.

When the crucible was cold, the matter which it contained was washed with water; muriatic acid was added to this water, until it was in great excess; the liquor was then filtered; sulphuric acid precipitated the barytes in the state of sulphate; it was then evaporated to dryness; the residue was after this dissolved in water, and supersaturated with ammonia; the liquor filtered, evaporated, and the residue heated in a slightly red heat, to drive off the sulphate of ammonia. There was from this a small residue, which was added to what was put apart in the first part of the experiment.

These two residues being dissolved in water, and crystallized, weighed twelve decigrammes. Their solution formed, with that of platina, an orange precipitate; and the last portions of the mixture, in evaporating, left needle-like crystals similar to those of the triple salt of platina and of soda.

In order to know if the precipitate was caused by some of the ammonia, which had not evaporated, it was treated with aqua regia; but this did not make it disappear; another part mixed with caustic potash did not cause any perception of ammoniacal vapour. It was concluded, from those two experiments, that the yellow precipitate was occasioned by potash; and as the needle-like crystals, perceived in the liquor, were indubitably caused by soda, the presence of the two alkalis in obsidien may be considered as certain. In estimating at ten or eleven per cent. the alkali contained in this stone, the proportion was considered not to be over-rated.

The following are the substances contained in the obsidien according to this analysis:

Silex	72
Alumine	12,5
Iron and manganese oxyds	2
Potash and Soda	10
	96,5
Loss	3,5

Analysis of two other kinds of Obsidien, brought over by M. Humboldt.

By M. Drappier.—*Ann. Chem.* Vol. 53.

M. Drappier employed the same method of analysis as M. Descostils, which is already recited. The only other substance he found in those two specimens, besides what was found in the other, was lime, and that but in a very small quantity. He did not separate the iron from the manganese in the statement, because that it was found in a portion almost too minute to be weighed;

and the potash, in like manner, was found in a very small proportion in both.

The specimen, No. 4, contained a little more of it than No. 3. The soda was estimated by weighing the dry sulphate of soda obtained. No. 3. yielded of it 8,80 to the hundred, and No. 4. 10,6: which gives 3,30 of soda for the first, and 4 for the second, after the analysis of the crystallised sulphate of soda, which contained of it 15 per cent.

Analysis of the two Specimens of Obsidien.

	No. 3.	No. 4.
Silex	74	71
Alumine	14,20	13,40
Oxyd of iron and manganese	3	4
Lime	1,20	1,60
Soda and potash	3,30	4
Loss	4,30	6
	100	100

Analysis of Tin in Grains, brought from Guanaxuato in Mexico, by M. Humboldt.

By M. C. Descostils.—*Ann. Chem.* Vol. 53.

The specific gravity of this tin is 5,0666; heated to redness, it loses nothing of its weight.

Fifty-five decigrammes, well pulverised and moistened with oil, were put into a crucible with charcoal dust, on which was thrown a little gum water. When the crucible was red hot, the bellows were used, and continued to be so for 25 minutes.

The crucible being broke, there was found a button of tin of the weight of three grammes and 76 centigrammes (about 48 grains), which was in the proportion of 68,36 to the hundred. It contained a little iron. Above it was a little vitreous globule, of a greenish colour, which no doubt, proceeded from the vitrification of a little oxyd of iron, and some earthy substances. It was separated by the hammer before the metallic button was weighed, five grammes (about 67 grains), having been heated with potash in a silver crucible. The mass diluted with water was dissolved by muriatic acid. It was then saturated with solution of caustic potash, which was added in excess. The greatest part was dissolved; there remained a red precipitate, which still contained oxyd of tin. This precipitate, well dried, weighed 62 centigrammes (about nine grains). It was then mixed with weak muriatic acid, which left behind oxyd of tin equal to more than the half of the whole precipitate, so that the oxyd of tin may be justly estimated at one-twentieth.

It is possible that another portion might yield proportions a little different, for the colour of the grains of tin ore was not always the same, and the proportion of the white to the brown particles varying considerably, it would not be wonderful if the quantity of iron, which produced the brown colour, should be a little more or less abundant in different parcels. The following, however, were the proportions found in this analysis.

Oxyd of tin - - -	95
Oxyd of iron - - -	5
	100

Analysis of the brown Ore of Lead of Zimapan, in Mexico, brought over by M. HUMBOLDT.

By M. COLLET DESCOSTILS.—*Ann. Chem.* Vol. 53.

THIS ore, heated on charcoal by the blow-pipe, yields sometimes a slight odour of arsenic; it fuses readily, and after boiling up strongly, small globules of lead are seen covering the coal.

Heated with borax, it melts easily, and gives it a light emerald green colour.

M. Del Rio having asserted that this mineral contains neither chrome nor uranium, M Descostils examined into the truth of this statement as follows. He pulverised 25 decigrammes (about 37 grains) of this ore and slightly heated it along with diluted nitric acid. The liquor soon assumed a clear yellow colour, a little greenish; all the ore dissolved without any sensible effervescence, except a small portion of a red colour, which proved to be oxyd of iron mixed with a very small quantity of silex and of chromic acid. Some concentrated sulphuric acid, added to the yellow liquor, occasioned a white precipitate, which was perceived to be sulphate of lead.

The liquor filtered, "*evaporated to dryness, and saturated with ammoniac, did not deposit any perceptible precipitate;*" the excess of the alkali was driven off by heat; the nitrate of lead formed in "*this liquor*" a yellow precipitate, similar to chromate of lead; it contained a little sulphate (of lead) on account of the excess of sulphuric acid employed in precipitating the lead; but in separating those two salts by nitric acid, (which dissolved the chromate, without perceptibly affecting the sulphate) the respective proportions of both salts were readily ascertained.

Another experiment, in which muriatic acid was used to dissolve the ore, which was afterwards driven off by evaporation, effectively proved the existence of the chromic acid, for it gave, with nitrate of silver, a beautiful red colour. The same effect could not be produced by nitrate of mercury; but it is known

that this re-agent does not always cause the same tint; that which it gave on this occasion was yellowish.

To discover if the ore contained any thing volatile, five grammes (about 77 grains) was put with powdered charcoal into an earthen retort, and exposed for an hour or two in a red heat nearly approaching to white. It discharged a little muriatic acid. After having broken the retort, some little metallic globules were perceived adhering to the upper part; they were not larger than heads of the smallest pins, and had all the appearance of the ductility of lead.

What remained in the retort, did not seem to have experienced any sensible alteration, and was as pulverulent as when introduced. After the charcoal was burned away on a little porcelain test, the remainder was fused with black flux, and a button of lead obtained from it, which gave no trace of silver on the cuppel. The weight of the button of lead is not stated, because some of the substance in the retort was lost in breaking it, and therefore the produce was less than it ought to be.

To know with precision the proportions of the constituent parts of the ore of M. Del Rio, a new experiment was made, in which the quantity of muriatic acid contained was determined by nitrate of silver. The proportions were as follows:

Metallic lead - - - -	69
Oxygen computed - - -	5,2
Oxyd of iron insoluble in nitric acid -	3,5
Dry muriatic acid - - -	1,5
Chromic acid - - - -	16
Loss - - - - -	4,8
	100

M. Del Rio had asserted, that he discovered a new metal in this ore, but the experiments stated convince M. Descostils that this opinion was unfounded.

Observations.—In one part of the relation of this analysis in the original, there is a little deficiency. The passage, literally translated, is marked with inverted commas. This method was preferred to arbitrary correction, that our readers might judge for themselves how far the following alteration of it is right:

"The liquor filtered, and saturated with ammoniac, did not "deposit any perceptible precipitate; being then evaporated to "dryness, the excess of the alkali was driven off by heat. The "nitrate of lead formed in the above-mentioned liquor a yellow "precipitate, *&c.*"

Analytic Memoir on the different Humours of the Eye, with a view to discover the Causes of the Cataract.

By M. NICOLAS, *Doctor of Physic, &c.—Ann. Chem.* Vol. 53.

WHILE M. Nicolas was engaged in the analysis of the humours of the eye, Mr. Chenevix, F.R.S. was also employed in the same pursuit, and read an account of his analysis to the Royal Society of London, previous to the publication of this, which will be noticed in the course of this Memoir.

The experiments were chiefly made on the eyes of sheep and oxen, and some comparative experiments were also made on the human eye.

Of the aqueous humour.

1. The aqueous humour has the limpidity and transparency of the purest water, but is not altogether so liquid.

2. This liquor is colourless, and has a slightly salt taste.

3. When quite fresh, its specific gravity is 1009, that of water being 1000.

4. This humour in a fresh state turns green blue vegetable tincture made from mallows in the cold with distilled water.

5. It precipitates the nitrate of silver in a curdy state, which precipitate, by degrees, assumes a violet tinge, which indicates the presence of a muriate in this humour.

6. It likewise precipitates acetate of lead; the precipitate remains flakey, and assumes a light grey colour.

7. The oxalate of ammonia added to it, causes a precipitate of oxalate of lime, but in a very small quantity.

8. Lime water loses its transparency on being mixed with this humour, and, after some time a precipitate is deposited, which, on examination, is found to be phosphate of lime.

9. In order to leave no doubt of the existence of a phosphate in this humour, a small quantity of very pure muriatic acid was added to it. The acid immediately coagulated the animal matter, and then acted on the lime in displacing the phosphoric acid. The lime may be rendered perceptible by adding oxalate of ammonia to the muriatic liquor after it is filtered, and lime water detects the existence of phosphoric acid.

10. The tanning liquor precipitates gelaten from it.

11. An infusion of gall nuts made in the cold, in distilled water, and mixed with this humour, coagulates it, but produces only a slight change in point of colour, which assumes a slight violet tinge alone.

12. Alcohol renders it white immediately, and partly coagulates it.

13. The aqueous humour exposed to a heat of from 60 to 70 degrees, coagulates in part, in rendering visible white flakes which swim in the uncoagulated part, which were evidently alumen.

These experiments afford reason to conclude that the aqueous humour of the eye is composed of water of gelaten and alumen, holding in solution a little muriate of soda, and a very small quantity of phosphate of lime.

This differs from the account of Mr. Chenevix's Analysis, in which was stated, 1st. that the aqueous humour produced no perceptible change in the vegetable tinctures. 2d. That no phosphate of lime could be discovered in it, although M. Fourcroy had before perceived it. Thirdly, and lastly, that it was composed of water, gelaten, albumen, and muriate of soda alone.

Of the vitreous humour.

1. This humour is in the form of a jelly, colourless, and of the greatest transparency.

2. When it is triturated in a glass mortar, with a little distilled water, in the cold, it is only in part dissolved, there remain little membranes which appear to be insoluble, and the liquor, being filtered, becomes limpid.

3. Its specific gravity is a little greater than that of the aqueous humour.

Its analysis in other respects gives the same results as that of the aqueous humour, and it only appears to differ from it by a somewhat greater concentration of its principles.

The experiments which M. Chenevix made on the vitreous humour differed only from those of Nicolas, in not exhibiting the existence of phosphate of lime in it, and in omiting to note that its specific gravity was superior to that of the aqueous humour.

Of the crystalline humour.

The third humour of the eye is called the crystalline, on account of its transparency, and its vitreous appearance, similar to crystal. The crystalline of a sheep weighs 26¼ grains, and that of an ox 38. The crystalline has a lenticular form, but in most animals its front part is a little flatter than its back part.

The crystalline appears to be composed of a vast number of very thin laminæ, and of extremely minute fibres, very transparent, and closely united together.

The crystalline is placed at the front part of the vitreous humour, and is there set in it like a jewel in a ring, a little membrane called the crystaloide and the aracnoides serves to join it to them; it is between this membrane and the cornea in the front of the crystalline that the aqueous humour is formed. The iris forms a circle round the edge of the crystalline, and adheres strongly to it.

1. The specific gravity of the crystalline is much greater than that of the two other humours of the eye.

2. Its consistence is not uniform in all its parts; the outward part is soft and gelatinous, the central part, or the kernel, is compact and firm, and the intermediate part, between both, is more consistent than the first.

3. It has a reddish tinge in the eye of a fœtus, is devoid of colour in young animals, and assumes a yellowish tint after maturity; this colour acquires farther intensity in old age.

4. The crystalline triturated in the cold, in a glass mortar with distilled water, communicates viscosity to it, and dissolves it almost entirely; but the solution becomes milky, and it is only after some time that it becomes limpid after being filtered; it is on this solution made from eight crystallines of sheep in twelve ounces of distilled water, that the following experiments were made.

5. This liquor, mixed with the tincture of mallow flowers, communicated to it a green colour.

6. The infusions of gall-nuts produced in it an abundant precipitate of a dirty white colour.

7. Lime-water rendered it somewhat cloudy, and caused it to deposit a small precipitate.

8. Oxalate of ammonia rendered it less clear, and by degrees caused a precipitate, which consisted of oxalate of lime, mixed with a little alumen.

9. The tanning liquor precipitated likewise from it a little gelaten coloured brown.

10. The nitrate of silver occasioned a precipitate of a deep brown colour

11. Muriatic acid caused a precipitate of a beautiful white colour, and flakey consistence, which resulted from the coagulation of the alumen by the acid.

12. The acid liquor being separated from the alumen by the filter, and mixed with oxalate of lime, precipitated oxalate of lime.

13. Boiling water dissolved but a small part of the crystalline; it grew hard in it, lost its transparency, and became of a dull white.

14. Alcohol hardened it; its external part became white as chalk, and then, with the point of a knife, successive white layers or membranes might be raised from it, which were placed one over another; but the centre, or the kernel, preserved its transparency.

15. The crystalline divided into small fragments, being put to macerate in pure muriatic acid, the phosphate of lime that was in it became decomposed, the phosphoric acid was disengaged, and the lime united to the muriatic acid, which may be rendered perceptible, by pouring some drops of this solution into lime-water, which grows whitish directly, and a little after deposits a precipitate, which is phosphate of lime alone.

It results from these experiments, that the crystalline is formed of a humour of three different densities, that is to say, its exterior

is soft, and appears to be formed of albumen and gelatin; that the intermediate part, although of the same nature, contains less gelatin and more albumen; that the central part is more solid than the intermediate part, and contains scarce any gelatin; and that, finally, phosphate of lime is found in all the parts of the crystalline, but in different proportions; that is to say, rather plentifully in the central part, in less quantity in the intermediate part, and in a still smaller proportion in the external part.

The experiments which were made on many human eyes, convinced M. Nicolas, that the human eye was absolutely of the same nature as that of the sheep; some slight difference was, however, observed in the specific gravities of their humours, namely, that the aqueous crystalline and vitreous humours of a man's eye were somewhat inferior in density to those of a sheep.

Conclusion.—We have seen that the organ of vision is formed of humours of different degrees of density, of specific gravity, and of consistence, which are all essential to the perfection of sight; for the different densities observed in the humours of the eye are absolutely necessary to produce achromatic effects; that is to say, to correct or modify the different refrangibility of the rays of light, which might injure the precision of the images formed on the retina: the crystalline is particularly destined to break the rays of light, to collect them on the retina, and consequently to form the images of the object which occur to us; but it is the aqueous humour that commences the refraction, which the crystalline afterwards completes, by the aid of the vitreous humour.

The mechanism of the artificial eye, and the contrivance of the darkened chamber, by demonstrating those truths, affords us a means of accounting for the faculty we possess of distinguishing the form and colour of the objects to which we turn our attention.

The dispositions of the eye, which occasion some to be short-sighted, and others to see best at a distance, depend on the configuration of the crystalline; those in which it is too convex experience the first-mentioned effect, and those in whom it is too flat the second; almost all old people suffer the latter evil.

There remains now to say a few words on a species of blindness caused by the opacity of the crystalline, which is called the cataract. On this subject M. Nicolas observes, that the cataract depends on the nature of the substances composing the crystalline, which are subject, like most other animal matters, to become horney, and thus grow opaque, after violent inflammation of the eye, occasioned by the shock of a hard body, or any other cause. Long exposure to a burning sun, or very powerful fire, occasions also this complaint; from the latter cause, smiths, glass-blowers, and others of similar occupations, are liable to contract this disorder. The aqueous humour also running off from a wound in the cornea, or in any other manner, causes the cataract, if this humour is not again supplied; and, finally, the most com-

mon cause is the obliteration of the very minute arterial veinous and lymphatic vessels which supply the humours to the eye, and again draw them off when they have performed those reparatory functions to the crystalline and vitreous humours for which nature has designed them.

Observations.—The eye is one of the most important members of the body; it is one of the first perfected, and it is curious to observe, that there is a time when in the embryo the visual organs exceed in size all the other parts of the body, as may be readily seen in those in eggs a few days after the commencement of incubation.

As nothing can be more afflicting than the loss of sight, or which renders the sufferer more useless to the world, and more entirely at the mercy of others for every necessary or comfort; hence every thing which tends to throw light on the causes of this dreadful malady, must be of importance, and still more so must be the dissemination of intelligence where those who are threatened with this evil may, in the first stages of the disorder, find such relief, as, in most cases, will avert the impending calamity; for these reasons, in addition to the information contained in this paper, we think it a duty of humanity to mention the very benevolent institution for the relief of those afflicted with disorders of the eye, and of the ear, which a society of gentlemen have founded in Charter-house-square, through the benevolent and indefatigable exertions of Surgeon Saunders, who, at a considerable expence to himself, devotes his time there to the charitable relief of those poor patients whom want of means must otherwise have precluded from timely assistance: there is no doubt but so humane and necessary an institution will be imitated in other situations, which we understand is already the case in one instance at least; and that thus the means of relief for complaints leading to so dreadful a calamity may be as extended as they ought to be. In this case those benevolent gentlemen who first established the above-mentioned charity will have the additional satisfaction of doing good extensively by their praise-worthy example, as they have already by their liberality and benevolent exertions.

On the Bleaching Powder of Tennant and Knox, of Scotland.

By M. Alyon.—*Ann. Chem. Vol.* 53.

The discovery of oxygenated muriatic acid by Scheele has added great light to chemistry. The fine experiments of M. Berthollet on this substance, and his application of it to the arts, are known to all Europe. Nevertheless, his proceedings, as he himself acknowledged, were open to improvement in the bleaching department: how injurious the vapour of this acid is to the workmen when they operate on a large scale, all have experienced

who have established bleaching-houses on Berthollet's principles. To remedy the great volatility of the acid, potash, lime, and other matters have been used; and hence has proceeded the javelle lie, which is now in common use for domestic purposes. Many English chemists have proposed a super-oxygenated muriate of lime, to simplify Berthollet's mode of bleaching, of which the latter has given an account in his last edition of his Art of Dying. Many who have bleaching-houses on Berthollet's plan, have tried all these methods, but have found nothing that answered their purpose so well as the powder of Tenant and Knox. The discovery of the composition of this powder was made by M. Alyon through the following circumstances.

Before the war, large quantities of the above powder were exported to the continent. A Belgian bleacher, who had a large establishment at Brussels, bought two hundred weight of it; but he had hardly used it before Messrs. Tenant and Knox informed him, by letter, that the exportation was prohibited, and that therefore they could send him no more. Shortly after, he came to Paris, and brought with him a few ounces of this powder, which remained, and gave it to one of M. Alyon's friends, who interested himself about bleaching concerns also: these gentlemen analysed this powder, and were convinced that it consisted of a mixture of super-oxygenated muriate of soda and of lime. Messrs. Tenant and Knox composed it with one third of muriate of soda and two thirds of lime slacked in water, and dried, which they saturated with oxygenated muriatic acid gas; but M. Alyon's friend was convinced that the lime was in too great a proportion, and he fixed the relative quantities of the composition as follows:

Muriate of soda - - - -	15 pounds.
Sulphuric acid diluted with one half water	10
Oxyd of manganese - - -	5

This was put altogether into a large matrass of glass, to which was fitted a tube of glass or lead, which was made to descend into a vessel of earthenware or wood, some pebbles were placed about the lower orifice of the tube, to prevent its being closed up, the tube was luted to the matrass, and there was put into the vessel round about the tube, a mixture of three pounds of lime slacked, and well dried, and of eight pounds of sea salt grossly pounded: the matrass was heated in a sand bath, and, when the gas began to be disengaged, the powder was stirred with a wooden spatula, and absorbed the gas as fast as it came over. When no more gas passed, the operation ended, the powder was then put up in a barrel, or in glass bottles. It very strongly attracts the moisture of the air; when an ounce or two of it is put into a large glass of water, it throws out a sufficient quantity of oxygenated muriatic gas, to form a good anti-contagious fumigation; but more gas would be disengaged, if a few drops of acid of vitriol were put into the water which holds the powder in solution. As to domestic purposes it is of great utility. Two ounces of this powder in a pint

of common water, with eight drops of vitriolic acid, surpasses in quality a pint of the javelle liquor in its bleaching qualities. The cheapness of its preparation ought to render its use more extensive; those in France who do not choose to be at the trouble of making it, M. Alyon adds, may buy it ready prepared at M. Fouques's bleach-house in Paris, and that he thinks he has done a public service in relating the method of making it, as the English keep it a secret.

Observations.—The last remark of M. Alyon is not correct. Messrs. Tenant and Knox took a patent for their composition, and of course were obliged to make it public, by registering the specification in Chancery, and which has been published in the Repertory of Arts, Vol. IX. first series; their patent right was afterwards set aside by a legal decision against them, for an account of which see also Repertory of Arts, Vol. II. new series; and the public are therefore at liberty to use it freely. Perhaps M. Alyon's method of making it may be more expedient than that mentioned in the specification of the patent, and therefore we insert this paper.

Account of a Method of gilding Steel by Immersion in a liquid.

By Mr. STODART.—*Phil. Jour. No.* 43.

MR. STODART mentions that the discovery of this method of gilding belongs more to Mr. Hume, chemist, Long-acre, than to himself, by whose assistance he had few difficulties to overcome.

The method is as follows: To a saturated solution of gold in nitro-muriatic acid, add above three times the quantity of pure sulphuric ether; agitate them well for some time.

The gold will soon be taken up by the ether, in form of a nitro-muriate of gold, leaving the remaining acid colourless at the bottom of the vessel, which must now be drawn off by means of a stop-cock, or other similar contrivance. The acid being discharged, the instrument to be gilt, after being previously well polished, and wiped very clean, is to be dipped for an instant into the ethereal solution, and on withdrawing it as instantly washed by agitation in clean water. This is essential to get clear of a small portion of acid, necessarily taken up by the metal; and if this be neatly done, the surface of the steel will be completely and very beautifully covered with gold. Some little dexterity is necessary to perform the whole operation well.

Mr. Stodart tried some of the essential oils for the same purpose, knowing that they also will take gold from nitro-muriatic acid, but they would not answer the purpose of gilding as far as his experiments went; he owns that he did not prosecute this inquiry with much industry, as he had found all he wanted in the effect of ether.

Method of Coating Steel, or Brass, with Platina.

By Mr. STODART.—*Phil. Jour.* No. 44.

MR. STODART'S process for coating steel with platina, is nearly the same as that last described, the platina being used instead of the gold.

The platina is taken up from its solution by the ether with somewhat less avidity than gold; and is deposited on the surface of steel by the same management, or on polished iron, and in like manner forms a defence against rust: polished brass may also be coated with platina by the same operation.

Mr. Stodart thinks the platina should be perfectly pure to make the process succeed well; and that it was probably from want of attending to this circumstance that caused the ill success of the experiments of Dr. Lewis on the same subject. The platina coating is by no means so beautiful as that of gold, for which reason the latter will be preferred.

Mr. Stodart coated different parts of the same instrument with gold and with platina, and found the contrast of colour produced a very pleasing effect. He did not make any experiments of the effect of the essential oils on solution of platina, but expresses a wish that they will be made by others, who have more time and better knowledge of the subject.

Observations.—The principal object for which a coating is wanted for steel or iron to defend it against rust, is to prevent the decay of the coarser works of this metal exposed to the weather. Though the foregoing methods are not directly applicable to this purpose, on account of their cost, yet they furnish hints for experiments, which, perhaps, may lead to this desirable point. It is not improbable, that by some similar operation, iron may be coated with copper, sufficiently cheap to serve many useful purposes. Mere immersion in a solution of sulphate of copper is sufficient to give a thin coat of metallic copper to polished iron; but, perhaps, the coat might be thicker if the copper were first taken up by some preparation of an essential oil; for ether, it is imagined, would be too dear for this purpose in the large way.

Iron might, perhaps, be prepared for this purpose by sal-ammoniac, in the same manner as it is for manufacturing tinned plates; which would be cheaper than actually polishing it.

Of essential oils, that of turpentine is alone sufficiently cheap to be used in the large way to any profit.

On ascertaining more accurately the definitive Character of the primary Animal Fluids, and indicating their presence by exact Chemical Tests.

By Dr. BOSTOCK.—*Phil. Jour.* No. 44.

Dr. Bostock observes, that the different animal fluids have not yet been defined with sufficient precision, and gives instances where, even by medical writers, the terms *serous*, *mucous*, and *gelatinous*, are applied in such a vague sense, as oftentimes to be used for one another indiscriminately. The object of this paper is to ascertain the definitive character of the primary animal fluids, by which is meant those fluids, into which all the compound fluids in the animal body may be resolved by the application of different re-agents, without decomposing them into their ultimate elements.

Albumen.

The first of the animal fluids examined, was albumen. With the exception of water, no fluid appears to enter so largely into the composition of the animal body. It forms a very considerable proportion of the blood, and is found in greater or less quantity in nearly all the secretions. It is capable of assuming the solid form without undergoing any change in its chemical properties. In this state it constitutes the basis of all the membraneous substances, which are so extensively dispersed through every part of the system; it composes the cellular tissue, into which the earth of the bones, and the fibrous matter of the muscles, are deposited, while it enters largely into the structure of the skin, the glands, and the vessels.

Albumen is most conveniently obtained from white of egg. Dr. Bostock found that 100 parts of this substance contains 80 parts water, 15,5 parts solid albumen, and 4,5 parts uncoagulable matter.

The most distinguishing character of albumen is the property of being coagulated by heat. A solution of it in water was formed, which only contained one tenth of a grain of solid albumen to 100 of water, or an 0,001 part. This was exposed to the heat of boiling water, and a perceptible opacity was produced in the fluid.

One drop of the oxymuriate of mercury, added to a hundred grains of water, containing 0,001 parts of solid albumen, produced a very evident milkiness; and even in a solution of half the strength a sufficiently obvious effect was produced.

The nitro-muriate of tin is a powerful coagulator of albumen in its unmixed state, but is not so delicate a test as the oxymuriate of mercury. One hundred grains of water, containing one-fifth of a grain of albumen, was not affected by nitro-muriate of tin until after some hours, when the fluid exhibited a degree of milkiness.

To ascertain the effect of tannin on albumen, an infusion of galls was prepared, by infusing half an ounce of powdered galls in half a pint of water, and filtering the fluid, which contained 2½ grains of solid residuum to 100 water, equal parts of which were mixed with a solution of one part of albumen in 1000 of water. At first no effect could be perceived; but after some time an evident precipitate was formed, and slowly subsided.

Goulard's extract, dropped into a strong solution of albumen, immediately caused a very dense and copious precipitate.

It is difficult to determine how far this effect depends on the albumen itself, as goulard has been always considered as the appropriate test of the uncoagulable part of the serum of the blood, which resembles that of the white of egg; and as it is also decomposed by several of the saline bodies, which are found to exist in all animal fluids, and has even been found to yield a precipitate, when added to distilled water; and in all cases, after a few hours exposure to the atmosphere, the water to which it has been added becomes turbid, and is covered with a thin film.

In order to try the effects of this re-agent on albumen, one drop of it was added to 100 grains of water, by which its transparency was not affected. To this a single drop of a solution of albumen, of the same strength with that mentioned above, was added. It formed a dense precipitate, and, upon agitation, the whole was rendered milky. In this case, the proportion of water to the albumen was as 10,000 to one, and to the uncoagulable part of the white of egg as 30,000 to one.

One grain of saturated solution of nitrate of silver also produced a turbidness in the solution of $\frac{1}{10}$ grain albumen in 100 grains of water; and after some hours a curdy precipitate fell to the bottom of the vessel: as 100 grains of water, containing $\frac{1}{20000}$ grain of marine salt, was rendered evidently turbid by one drop of the nitrate of silver; it might be suspected that the effect was produced by the marine salt contained in the albumen; but the precipitate caused by the marine salt is in the form of a greyish powder, and subsides more rapidly than that produced by the albumen, which precipitate is white and flakey.

One drop of solution of nitro-muriate of gold immediately produced a dense-white precipitate, in 100 drops of water, containing one-tenth grain of albumen. Alum, though it powerfully coagulates albumen in a concentrated state, is not so accurate a test of its presence in a diluted state; one-fifth grain of albumen in 100 grains of water, was rendered slightly turbid by a few drops of saturated solution of alum, but no precipitate was formed.

Jelly.

The peculiar characteristic of this substance is its property of becoming concrete by cold, and being liquified by a gentle heat. It enters largely into the composition of the blood, though less largely than the albumen. It is also an ingredient in the skin,

membranous texture, ligaments, cartilages, and tendons. Jelly prepared by dissolving four grains of isinglass in 200 grains of water, was used in Dr. Bostock's experiments, forming a liquid by heat, of which one grain contained $\frac{1}{50}$ of jelly.

One part of jelly in 100 of water produced a compound perfectly stiffened by cooling, but one part jelly to 150 water, though evidently gelatinous, did not stiffen.

Jelly is copiously precipitated by tannin; five grains of the standard solution of jelly and 95 of water, to which was added an equal quantity of infusion of galls, of the same strength, used in the experiments on albumen, deposited an abundant precipitate.

The solution of jelly was afterwards reduced in strength till it contained but $\frac{1}{1000}$ part of jelly, and still a precipitate was produced by the infusion of galls.

Goulard's extract added to the above solution of jelly, by a few drops, had no more effect on it than the same quantity of pure water.

The oxymuriate of mercury produced no effect on the standard solution. The nitrate of silver and nitrate of tin were also employed, and produced a very slight, and almost imperceptible opacity. Nitro-muriate of gold produced a small quantity of dense precipitate; but when the solution was diluted so as to contain only one grain of jelly to 500 of water, the effect was no longer apparent.

Mucus.

Animal mucus or mucilage enters largely into the constitution of many parts of the body, and forms a considerable proportion of the secretions. Mr. Hatchet first defined this substance to be only a modification of jelly, and Dr Thompson follows him in this opinion; but, Dr. Bostock, from his experiments, proves that there is a considerable difference between those substances, and that mucus more resembles vegetable gum.

The mucus employed was obtained by agitating an oyster a few minutes in cold water, and also that contained in saliva.

The saliva being agitated in cold water, a part dissolved, this water was filtered, and by a careful evaporation, it was found to contain $\frac{1}{210}$ part of its weight of mucus.

No effect was produced in a similar solution of mucus of saliva by the oxymuriate of mercury, and the nitro-muriate of tin caused only a slight opacity. No effect was produced by the addition of an equal quantity of infusion of galls.

Goulard's extract produced an immediate opacity, and after some time a white flakey precipitate fell to the bottom of the glass. No appearance of coagulation was produced by exposing the fluid for some time to the heat of boiling water, nor any tendency to gelatenize by evaporating and cooling it.

The mucus procured by agitating an oyster in water was found, on evaporation, to contain $\frac{1}{10}$ of its weight of animal matter: a

quantity of this solution, with an equal bulk of water, was used in the experiments.

The same results nearly were produced by this solution, as by that of saliva mucus; in both cases no effect was produced by oxymuriate of mercury, thus proving the absence of albumen. The small precipitate caused by the infusion of galls, indicates the existence of only a very minute portion of jelly. The effect was scarcely as much as was produced by the same re-agent on a solution of one part of jelly in 5000 of water; so that very nearly the whole of the animal matter probably consisted of mucus, the presence of which was indicated by the goulard.

These experiments exhibit a decided and essential difference between jelly and mucus; independent of the gelatenizing property of the latter, the effects produced in them by tannin and goulard's extract are exactly opposite.

Tannin is a most delicate test of jelly, but does not in any degree affect mucus. Goulard is a delicate test of mucus, but does not in any degree affect jelly. The oxymuriate of mercury, on the contrary, which is one of the most accurate tests of albumen, does not appear to be affected either by jelly or by mucus.

It appears from what precedes that oxymuriate of mercury, tannin, and goulard, are the three most valuable tests for animal fluids.

Albumen is known by coagulability from heat, and precipitation by oxymuriate of mercury.

Jelly is known by its concretion on cooling, and its precipitation by tan; and mucus is known by its precipitation by goulard; and negatively, by not being coagulable by heat, nor capable of being gelatenized, or precipitated by the oxymuriate of mercury, or by tan.

In the analysis of a fluid which is supposed to contain only the three substances treated of, the first step should be to observe the effect of oxymuriate of mercury; if this produce no precipitate, we may be certain the fluid contains no albumen. Infusion of galls should next be employed; and if this also causes no precipitate, we may conclude that the animal matter held in solution, consists of mucus alone, which may be farther proved by goulard's extract.

There is a great resemblance between the mechanical effects of animal mucus and vegetable gum, and also in their chemical properties. A solution of gum arabic, containing one grain of gum, in 200 of water, was not affected either by the oxymuriate of mercury or by tan. With the nitro-muriate of tin and with the nitrate of silver, there was only a slight opacity caused, but with goulard's extract, there was a dense precipitate instantly formed.

Muriatic Acid, asserted to be produced by the Galvanic Decomposition of Water, by Dr. PACCHIONI, *of Pisa; and of Muriatic Salts produced in like manner.—Edin. Med. Jour. July 1805.*

A LETTER from Dr. Francisco Pacchioni, of Pisa, to Sig. Pighotti has been published in the Edinburgh Medical Journal, in which the Doctor asserts his having produced marine acid by the galvanic decomposition of water.

Having constructed a simple apparatus by which the oxygen and hydrogen were given off in different vessels of water, but which he does not describe, he observed, that pure oxygen was emitted from the gold wire, that the water became acid, and when, by proceeding in the operation, the residual fluid occupied about half the capacity of the receiver, (or when half the fluid probably in one of the vessels had disappeared) the remainder was found to be of an orange colour, more deep as the quantity of fluid was less. It resembled a solution of gold. From the lower orifice of the vessel, which was closed with a piece of taffety, and then with double bladder, a smell was emitted of oxygenated muriatic acid. The gold wire appeared corroded. The bit of taffety had been affected by the fluid so as to be easily torn. Round the edges of the vessel on the bladder was a deep purple ring, and within that a circular space rendered colourless or white: a drop of the fluid itself tinged the skin of the hand, after some hours, of a beautiful rose colour.

The same fluid, possessing constantly the same properties, was obtained in various repetitions of the experiment. It was shewn to contain a volatile acid by the white vapours which were formed by ammonia placed near it. It threw down a curdy precipitate from nitrate of silver, which the author concludes to have been the muriate of that metal; and from the whole of the facts he concludes that muriatic acid is produced from water by depriving it of part of its oxygen; that muriatic acid is, therefore, an oxyd of hydrogen; that in oxygenated muriatic acid, and, therefore, *à fortiori* in muriatic acid, there is a less proportion of oxygen than in water; and that hydrogen may have many different degrees of oxydation.

The author promises to treat of the other oxyds of hydrogen shortly in another memoir, and observes, that having thus determined the origin and nature of the muriatic acid, there is no longer any mystery in its formation nor in that of the muriatic salts in the vast extent of the ocean.

In addition to the preceding account, notice is taken of the early discovery of Mr. Cruickshank (published in Mr. Nicholson's Philosophical Journal for 1801), that infusion of litmus was

reddened by one end of the galvanic pile, and infusion of Brazil wood rendered purple by the other, which he ascribed to the formation of nitrous acid and ammonia; and mention is also made of the discovery of Mr. Peel, of Cambridge, made in April 1805, announced in Mr. Tilloch's Philosophical Magazine, of the formation of muriate of soda by the action of the galvanic pile. Mr. Peel decomposed one half of a pint of distilled water, the other half being evaporated, left a small portion of muriate of soda; great attention had been paid to the purity of the water, and a careful repetition of the experiment produced the same result.

Since the paper from whence the above was extracted has been published, another letter has appeared from Mr. Peel, in the Philosophical Magazine, which mentions, that on trying the experiment again with water produced from its elements, *muriate of potash* was found in the residual water, instead of muriate of soda. Mr. Peel formed water from hydrogen and oxygen, and the water being somewhat acidulous, (which he found to be caused by nitric acid), as was always the case when these two gases were not perfectly pure, and in exact proportion, he added lime to this water, to neutralize the acid, and distilled the water; which being decomposed to one half by the galvanic process, the residuum produced *muriate of potash*, to the great surprise of Mr. Peel, for which he owns himself unable to account.

Observations.—It is to be wished that Dr. Paechioni had related more details of his experiments, and described his apparatus; without which it is impossible to form a judgment of the degree of assent which should be given to the extraordinary fact he announces, or to the inferences he draws from it.

It seems so contrary to all analogy that the higher degree of oxygenation should produce a substance of no sensible acid properties, that the lower state should produce one in which they are very apparent, and the intermediate degree, one in which they are so extremely perceptible; that at least some hesitation may be allowed, and a desire to defer assent, till more has appeared on the subject, is certainly excusable.

As on a subject where so little light can as yet be had conjectures are allowable, the writer begs leave to suggest, that as in the galvanic apparatus, muriate of soda, or muriate of ammonia, are often used to give the water more effect on the zinc and copper, so, (if these had been used in the recited experiments) the electric fluid, in passing from the apparatus, might have actually brought along with it the muriatic acid of the salts into the distilled water, or even the salt itself in solution of aqueous vapour; or if not the last, the alkali of the salts found might be contained even in the distilled water. Mr. Tilloch conjectures, that in Mr. Peel's last experiment lime might have been in the distilled water, and that, as Guyton has given some reason to suppose that potash is composed of lime and hydrogen, the potash might have been produced by the lime uniting to the hydrogen of the water. Mr. Til-

loch also recommends, that the water which produces muriate of soda by the galvanic action, should be examined as to its containing magnesia, as Guyton has also shewn cause to imagine that soda is produced from magnesia and hydrogen.

It seems necessary, in order to determine the conjectures arising from the recited experiments, that water should be used both in the galvanic apparatus, and for the decomposition, unmixed with any species of salt, acid, or earth, in future experiments, and as much freed from what it might contain naturally, as was possible, without adding any one of these substances to remove any of the rest: as there is the greatest reason to believe that some part of every substance, added to any mixture, remains united to it afterwards; and that, therefore, the complete and absolute separation of various matters, (held in chemical union, in either natural or artificial mixtures), which is pretended to in various chemical experiments, is in many instances imaginary; which opinion is much confirmed by the facts recited in Berthollet's admirable Treatise on Chemical Affinities.

Signor Volta mentions (in the account published of his experiments, Phil. Jour. Vol. I. 8vo.), that he made a powerful galvanic apparatus, in which *pure water* was alone used, with 30 glasses communicating in succession by separate metallic wires, which terminated each at one end in a plate of zinc, and at the other in a plate of copper; which shews that no impossibility is directed in the proposed experiment, as might be imagined from the result of Mr. Davy's experiments—that when the water between the plates, in a galvanic pile, was quite pure, no effect was produced, and that it was, therefore, necessary to mix it with a salt or an acid: the seeming contradiction of the experiments of these gentlemen may be accounted for, by supposing, that the difference of the apparatus of glass cups from that of the pile of plates, might somehow occasion a different action.

As a confirmation of the opinion before given, (that the acid and salts, found in the experiments recited in this paper, might have proceeded from the galvanic apparatus along with the electric fluid). Mr. Giobert's experiments, mentioned in a letter to Van Mons, may be stated, in which "he caused *even indigo to circulate by im-* "*pregnating the pasteboard disks*, of the galvanic pile, *with a* "*solution of that substance in sulphuric acid.*' 'Mr. Giobert also there gives it as his opinion, that "*the gases came from the pile* "*and were not formed at the extremity of the wire where they were* "*disengaged.*" In this case "the decomposition of the water is "affected in the pile by means of the zinc, which circumstance "may be classed among the chemical phenomena best known." He farther states, that "if the interposed pieces, of pasteboard "are impregnated with pure ammonia, and the wires immersed, "particularly the negative, in a solution of alum, a precipitate "will be instantly formed in it by the ammonia *which will be* "*conducted by the wire.*"

Account of an Earth found in Devonshire, consisting principally of Alumine and Water analysed.

By Mr. H. Davy, *F.R.S.—Phil. Trans. of* 1805.

This earth was discovered many years ago in a quarry near Barnstaple, by Dr. Wavell, who described it as filling some of the cavities and veins in a rock of soft argillaceous schist. Its most common appearance is in small hemispherical groupes of crystals, composed of a number of filaments radiating from a common centre, and inserted on the surface of the schist: its colour is white, in some cases, with a tinge of grey or green, and in a few instances yellow; some small fragments of it are so hard as to scratch agate: its lustre is silky, and though some specimens are semi-transparent, in general it is opaque.

It is soluble in the mineral acids, and in the fixed alkaline lixivia by heat; it is rendered opaque by the strong heat of a forge, but did not enter into fusion; it contains no alkali; its analysis produced the following results for one hundred parts:

Alumine	0,7
Lime	1,4
Water	26,2
Loss	2,4

No aluminous stone has been found which contains so large a proportion of water.

Mr. Davy mentions his having examined a similar fossil, from St. Austle, in Cornwall, and that an analysis of it, made by the Rev. William M'Gregor, proves it to consist of similar ingredients.

Observation.—The very small portions in which this fossil has been found, affords so little hopes of its being of any real utility, that we have foreborn to enter more largely into the very copious and accurate analysis which Mr. Davy has given of it, than merely to state the results.

Water formed by the mechanical Compression of Hydrogen and Oxygen Gases. By M. Biot.

In a sitting of the French National Institute, at the beginning of the present year, M. Biot read a paper on the formation of water by mere compression. The experiment of forming water out of its component parts, oxygen and hydrogen, by burning those gases by the electric spark, is well known. M. Biot has succeeded in making this combination independent of electricity.

by rapidly compressing a mixture of the two gases included in the iron barrel of an air gun, the breech of which being closed by a thick piece of glass, on the first stroke of the piston there immediately appeared a flash of light through the glass; a strong detonation took place, and the glass was driven out, and the copper ring broken, by which it was screwed fast; on repeating the experiment, a piece of copper was substituted for the glass, and firmly screwed in; after the mixture of the gases was introduced, on the first stroke of the piston a noise was heard like the smart crack of a whip; but a second stroke caused a violent explosion, which broke the barrel, or rather tore it asunder.

M. Biot accounts for this, by supposing that, in the same way that the known disengagement of heat from the compression of common air takes place, heat is also disengaged from these gases by the same operation in a very large quantity, which, as it cannot be immediately dissipated, raises their temperature for a moment, and in that state of compression is sufficient to inflame them.

M. Biot thinks that it is probable all the gaseous combinations which require an elevation of temperature might be formed in the same manner without any foreign agent. He also founds on these experiments the hypothesis, which he submits to the opinion of philosophers, that as the effect of electricity passed through gases may be caused by the compression it is known to occasion, that therefore the electric fluid may not be a fire, but only the cause of a rapid combustion in the air, through which it passes, by a violent compression from the extreme rapidity of its motion, and therefore the phenomenon called the electric spark may be merely a mechanical effect of this compression.

Observation.—M. Biot's discovery opens a large field for experiment on the gases, both for chemical purposes and the formation of explosive engines, which there is some reason to imagine might in some respects be superior to those in which gunpowder is used, and experiments in the latter way would be the safest, as there would be less danger of the explosion bursting the instrument. Against M. Biot's electrical theory there is one obvious objection, namely that the electric spark drawn from one wire to another is not merely visible in its passage alone, as must be the case if it arose solely from the compressed air in the interval, but is also seen on the extremity of the one wire in a state of accumulation before it darts off to the other.

Analysis of Hornblend, which gives reason to suppose it contains Tin. By M. B. G. Sage.—*Jour. Phys.* Vol. 58.

Hornblend is composed of opaque laminæ, more or less elongated, and sometimes rhomboidal. The colour of this mine-

ral is mostly of a greenish grey; some of it is of an emerald green, either dull or bright.

Hornblend is found mixed with quartz, feldspath, jade, and granite.

The orbicular rock of Olmetto, named improperly the *globular granite of Corsica*, exhibits hornblend disposed in concentric beds; this rock is composed of balls or globes of many inches diameter, formed of hornblend of a dark green, and of white feldspath, disposed in alternate layers, those of the feldspath are the thickest.

This orbicular rock is very scarce; there has been only one block of it found yet, which was discovered at the extremity of the Gulf of Valinco, near Istria.

There are some rocks in the Alps which resemble it; Saussure mentions that he discovered, near the Glacier of Miage, a bare rock, of a beautiful black, surrounded with concentric layers, alternately black and white; this rock appeared in detached blocks of from 30 to 40 feet in diameter. M. Saussure says these rocks are composed of feldspath and schorl in laminæ.

The ancients employed, to make vases, columns, and tables, a rock which they brought from Egypt, of which the body, a greenish white jade, was mixed with hornblend of a dark green. This rock took a beautiful polish, while that composed of jade and serpentine is not susceptible of an equal polish, because the latter substance is soft, and is rubbed down in the operation of polishing, deeper than the jade, which latter has the hardness of saphire.

The rock known by the name of the *hard green of Corsica*, is composed of jade of a violet tinge, and hornblend in flakes, bright, and of an emerald green, which caused M. Saussure to call it by the name of *Smaragdite*.

In the kingdom of Grenada, near the Lake Gatte, in the grey tufa, among the volcanic productions of Carboneira, hornblend is found crystallized in compressed hexhedral prisms, with trihedral and hexhedral summits, these crystals are about an inch long, and two or three lines thick.

A violent heat, long kept up, reduces to a cellular opaque glass the varieties of hornblend of a dark green.

N. Lampadius says, in the Journal of German Mines, that Werner observed the air to become soon vitiated in those mines wherein there was much hornblend. This property ought not to be attributed to the hornblend, because it does not form a bed for metals, except in the primitive mountains, and in any other circumstances it could have no power of making the air less pure. Very likely, Werner spoke of blend, which is a mineral of sulphurous zinc, from which might be exhaled, as from galena, a gas which would tarnish silver. Flies avoid those cabinets where there are many minerals exposed to the air and the light; M. Sage never saw any flies in the cabinet of minerals which he laid out during eighteen years.

The hornblend which I analysed was laminated, and of a blackish green colour; it was composed of alumen, of iron, of calcareous earth, and of a peculiar metallic substance. I disengaged the alumen by vitriolic acid, the calcareous earth by saccharine acid, the iron by sublimation with sal ammoniac, and the peculiar metal by fusion.

I distilled one part of hornblend with three of vitriolic acid three times successively, using fresh acid each time; the first and second times alum was produced, coloured with a little iron, from a ley formed with the residue; and each time the hornblend lost a twelfth of its weight; but the third time no alum was produced.

I distilled the remainder with three parts of sal ammoniac, which became sublimed along with the iron, which gave it a beautiful yellow colour; what remained in the retort was blackish: by this operation the hornblend lost a tenth of its weight, which was the iron contained. I believe it would not have resisted the action of the vitriolic acid, if it had not been combined with phosphoric acid, which the following experiments make probable.

The black colour of what was left after the distillation of the sal ammoniac with the hornblend, deprived of its alumen and the most of the iron it contained, made me suspect that it contained some other metallic substance: to determine this, I took a part of it with which I made a ball four lines in diameter, by mixing it with some common glue; I placed this in a crucible and exposed it to a violent fire for half an hour; after this I drew it out, when the ball shone in the midst of the surrounding charcoal with a bright green light, which I attributed to some kind of phosphorus.

The ball, when cold, exhibited a vitreous opaque mass of a grey colour, interspersed with bright metallic points, on which the file made no impression; I rubbed down this vitreous metallic mass, and separated the metallic particles, which did not in the least affect a very sensible magnetic needle.

Hornblend, from which neither the alumine nor the iron were separated, exposed to the fire in a crucible, produced a vitreous grey cellular globule, in which no metallic points could be perceived.

Hornblend, deprived of its alumen, and of the greatest part of its iron, having been vitrified on porcelain, produced a grey enamel similar to the glass of tin.

I said that the hornblend which I used was deprived only of the *greatest part* of its iron, for, having pounded in a copper mortar a part of the metallic balls obtained as described, I drew from it a thirty-second part of iron by a magnetic bar: some glass, being an enamel of tin of a greenish grey, being also pul-

verized in a copper mortar, had also in it some particles which were attracted by the magnet.

I do not absolutely conclude from these analogies, that the metal which constitutes a part of hornblend, is tin; perhaps it is a semi-metal possessing some similar properties, which is what I mean hereafter to investigate.

Mineralogical Description of Puy de Dome. By M. DAUBUISSON, *Jour. Phys.* Vol. 58.

PUY DE DOME has been long celebrated in the annals of the philosophical world: it was here that the well-known M. Pascal proved the facts relative to the weight of the air: it has since given its name to one of the French departments: but, above all, it affords to mineralogists the greatest interest, as a mountain almost singular in its kind, and as extraordinary in its form and position as in its nature.

This mountain is situated two leagues to the west of Clermont, in the midst of the chain of mountains called Puys, above all which it towers aloft. It rests upon a base of granite comprised between the valley of Allier and that of Sioule. The granite is laid bare at a small distance from the southern foot.

Its form is almost that of a truncated cone, of which the upper part presents some irregularities and eminences. It is absolutely isolated except on the north side, where it joins a volcano known by the name of the Little Puy de Dome, which seems growing from its side, and is only about one hundred and sixty yards lower than it: the height of the Great Puy de Dome is about six hundred yards above its foot, its lower base is about two thousand yards in diameter, and its summit about five hundred yards. Its sides are inclined from 40 to 50 degrees to the horizon; the western side is the most steep.

The sides and top are covered with a thick herbage; the rock does not penetrate through this herbaceous covering, but in one vertical streak on the southern side, and in some places in the upper parts towards the west, where it forms some excrescences like tumours; the surface or level which terminates the mountain, presents some eminences and little cavities, and bears towards the northern part a sort of head, which forms its summit. The mountain viewed from the plain, at the Clermont side, appears terminated by a convex top; it may be ascended by two ways, one at the south, along the streak of rocks before mentioned; the other way is at the east side; and first leads to the top of Little Puy-de-Dome, and from thence by the path of

Gravouse, traced along the northern side to the summit of the the Great Puy: it is by those ways that the herds of cows are driven up which go to pasture on its upper surface.

Wherever the rock is uncovered it appears of a porphyretic structure, that is to say, as to its principal mass, in every part of which crystals are found interspersed very uniformly. This mass has no resemblance to any mineral substances which I have seen out of Auvergne: It surprised Saussure when he saw it: it appears composed of the same elements as feldspath, but united in a confused manner.

Its chief colour is a whitish grey, sometimes it has a blackish appearance, and at other times, though rarely, it assumes a yellow and even a blue tint.

It is in amorphous masses which do not shew any tendency to regular division or stratification.

Its fracture is rough, earthy, and rarely even.

Its hardness varies: the black varieties cannot be indented with a knife: in others the hardness is so diminished, that it is almost friable.

Its specific gravity is from twice and a quarter to twice and a half that of water.

Exposed to the action of the blow-pipe, it fuses readily into a grey enamel.

Most of the varieties, which I have seen, absorb water, with a slight hissing noise.

The black varieties are the most compact, the most hard, the most weighty, and the most even in their fracture.

The mass contains many crystals, namely:

1st. Many crystals of feldspath of a whitish grey, almost always incomplete in their form; they appear sometimes hexedral prisms, having two opposite sides larger than the rest, and terminated at each extremity by two facets placed over the angles comprised by the narrowest sides of the prism; one of these facets is commonly larger than the other. They have but little brightness, are of a vitreous fracture, their laminæ are not always smooth, but, as it were, crossed by little fibres running lengthwise, which render them rough to the touch. They are sometimes transparent, at other times opaque. Exposed to the blow-pipe, they readily fuse into a white enamel.

2d. It contains scales of mica of a reddish brown, and sometimes blackish, and in a few instances of a pearly white. They form hexagonal laminæ which are sometimes the third of an inch in diameter, and are very shining.

3d. Some little acicular crystals of basaltic "amphibola."

4th. Some black grains, which are either amphibola or augite.

I observed that it was in the black varieties that amphibola

and augite were found. In the others there was more mica and feldspath.

The sides of some of the fissures in the Puy de Dome are covered in some places with a crust of specular iron: this mineral appears in little hexagonal laminæ, which form octohedrons a little irregular and very flat, and compose little cells by their arrangement.

The mass of rock is very subject to be decomposed by the action of the atmosphere; almost all the rocks of the mountain, which are uncovered, are become, at least at their surface, friable, and often earthy. The earth which is formed by their decomposition is of a dirty yellowish grey, and is composed of pulverulent particles, which do not seem likely to form a paste with water. In some places it has a blueish and cinereous appearance.

Towards the bottom, at the southern side, I found detached fragments, which exhibited spherical cavities, like bubbles; they were light, sonorous, rough to the touch, and seemed to bear appearances of the action of fire; but whether they were formed by the same cause which produced the mountain itself, or by the fires of some surrounding volcanoes, does not appear.

Finally, on the sides of the mountain are found some fragments of granite, as well as porphyry, of a black substance and apparently of volcanic origin, and of a very tenacious basalt, which contains some little grains of olivine, and which is found also in great quantities at the south-east part of the mountain. These substances are evidently different from those of the Puy, and probably came from the dilapidation of a small chapel which was once on the summit. Some volcanic scoriæ which are on the northern declivity, were probably thrown there by the Little Puy de Dome.

Such is the Great Puy de Dome; in seeing this colossal mass raise its majestic head above all the mountains of the country, without having any resemblance to them in its component parts, upon a base of a different nature, where it seems placed by enchantment, the observer naturally inquires what cause has produced it, and, for want of facts, hazards conjectures. Guettard considered it as granite fused in its bed; Saussure as a rock with a base of earthy feldspath slightly calcined by subterraneous fires; Messier, Monlosier, and Dolomieu thought, that it was raised by volcanic action in the state in which we see it, and by a sort of intumescence; finally, Leopold de Buch thought that it was a granite changed into a porphyry by the action of some vapour either of water or an acid, which at the same time by its expansive force raised this enormous mass.

By these contradictory opinions being assured of the little success any new conjecture of the origin of this mountain could have, I have confined my study solely to its structure, and only observe, that its mass has a great analogy to that of Mount Or, and that perhaps the origin of the one is not entirely independent of that of the other.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

Geological Observations, proving the ancient continuation of the Sea above the summits of the Mountains of Van Dieman's Land, New Holland, and the Island of Timor. By M. PERON.—*Jour. de Phys.* Vol. 59.

ONE of the most incontestable results of modern geological observations is the certainty that the ocean at some remote period was elevated far above its present level: the proofs of this fact are as numerous as they are evident: they appear strikingly in many different parts of the new continent: and, lately, M. Humboldt has communicated some of the most interesting relative to New Holland and Van Dieman's Land, which not having been before known, left a deficiency of proof that would prevent a rigorous naturalist from allowing the universality of the ancient dominion of the ocean, notwithstanding the existence of the most favourable analogy. This objection is now removed; on Van Dieman's Land, in many parts of New Holland, on the mountains of Timor, I have observed every where those estimable relics which are indubitable evidences of the revolutions of nature. In Van Dieman's Land, near the bottom of the North River, at six or seven hundred feet above the level of the sea, I observed great masses of petrified shells, all belonging to the genus *lime* of Lamark, and forming a species, to which I could perceive no analogy living in the same place.

On many parts of the eastern coast of the Isle of Maria may be observed regular horizontal beds of a species of stone formed of shells of a whitish colour lying on granite rock, from four to five hundred feet above the level of the sea.

At the Isle of Kangaroos, at those of St. Peter and St. Francis, and on the part of the continent adjoining to them,

there are always similar appearances, always relics of petrified shells, at greater or lesser elevations.

Vancouver and Menzies also observed the same in King George's Bay, and here I also saw some fragments of them.

In the excursion which my colleague M. Bailly made into the interior of New Holland, in going up along the Swan River, for the distance of twenty leagues, he every where found the soil of the country covered with a quartose sand mixed with the remains of shells.

At Sea-dog Bay this circumstance appeared in the most decided manner; the entire substance of the barren islands of Dorre and of Dirck-Hartog is formed of a concretion sometimes reddish, sometimes whitish, filled with different kinds of shells.

This composition is still more striking at Timor; at the summit of its mountains, at more than fifteen or eighteen hundred feet above the level of the sea, are to be found vast numbers of incrusted shells in the midst of masses of madrepore; the greatest part of these shells are in a silicious state, and some still calcareous are more or less friable; some of these shells are of a monstrous size: all my associates, as well as I, have seen many of them four or five feet long: one was so large that it was used as a trough for five or six pigs, and another in the Dutch fort served the soldiers of the garrison to wash their linen in. These shells were evidently of the species *Hippope* and *Tridacne* of M. Lamark, and much resemble smaller ones of the same sort, containing the living fish, found on the shore at the foot of the mountains. There were also many kinds of zoophites alive on the shore that appeared very similar to those which composed the mountains of this part of the island.

Zoophites observed at great heights above the Sea.

From the most southern extremity of the oriental hemisphere to the middle of the equatorial regions, at elevations more or less great, are to be found petrified shells either plain or incrusted; but the SOLID ZOOPHITES, of which I am going to make mention, are not to be met with to so great an extent. I could never perceive any great quantity of them beyond the thirty-fourth degree south, and it does not appear that any voyager has observed them beyond this point, or the same degree north.

Spread round the whole earth, it is in the bosom of the warmest seas that this innumerable race of animals seem to have fixed their habitation and their empire; it is in this last zone that they have raised exclusively those extensive reefs, those numerous isles, those vast *archipelagos* which are the prodigious monuments of their power. All the Society isles, Maitea, Tongatabou, Eona, Anamooka, and the Isle of Tortu

in the Pacific Ocean, New Caledonia, the islands of Chaine, Vethuroa, Tionkea, the isles Paliser, Tupai, and Moopchea, the Isle of Cocos, that of Pines, Norfolk Island, Howe Island, the Isle of Palmerston, most of the New Hebrides, the archipelago of the Friendly Islands, the Isle of Bougainville, many parts of New Guinea, all the islands off the eastern coast of New Holland, the formidable labyrinth of islands which was so nearly fatal to the ship of Captain Cook, and that of Bougainville; in a word, all those innumerable islands which are scattered over the great Equinoctial Ocean, seem, some entirely, others in part, to have been the work of those feeble animals. All the accounts of the voyagers who have passed through those seas, are filled with expressions of the terrors which their labours have occasioned: almost all have encountered the greatest dangers in the midst of those reefs which they have raised from the bottom of the sea to its surface; and most probably the unfortunate navigator, whose loss all Europe laments, (Perouse) was one of their numerous victims.

"The danger which they occasion," says M. de Labillard, "is so much the more formidable, as they form mounds of "rock, covered by the waves, which cannot be perceived but "at a very small distance. If a calm comes on, and the vessel "is drawn among them by the current, its loss is almost "inevitable, it is in vain to try to save it by throwing out "the anchor; it cannot reach the bottom, even when quite "close to those walls of coral, which rise perpendicularly "from the depths of the ocean. These fabrications of the "polypi, whose continual increase obstruct more and more "the bosom of the sea, may justly cause terror to navigators; "and many shallows which still afford a passage will, ere long, "become the most dangerous banks."

At King George's Bay, in De Nuyt's Land, these animals are first seen to assume that grand character which they exhibit in the equinoctial regions. I have not been able to examine this place sufficiently, and only picked up some fragments of zoophites from the earth here and there; but Vancouver and Menzies were more fortunate, and the accounts which they give are extremely interesting both in themselves and for the inferences which may be drawn from them: Vancouver writes as follows—

"The country is principally formed of coral, and it seems "that its elevation above the sea is of a modern date, for "not only the shores and the banks which extend along the "coast are composed of coral, as our sounding leads have "always brought it up, but we found it also on the tops of "the highest hills up which we ascended, particularly on the "summit of Bald Head, which is of that height that one can "see twelve or fourteen leagues distance from it. The coral here

"was in its primitive state, especially in one plain of about "eight acres, which did not produce the least herbage from "the white sand with which it was covered; but there rose "from it *branches of coral* exactly similar to those which the "beds of the same substance exhibit beneath the surface of "the sea, with ramifications of different thicknesses from five "inches to half an inch in circumference. Many of these "plains of coral are here to be met with, on which are to be "found also great quantities of sea shells, some perfect and "adhering to the coral, and others in different states of dis-"solution. The coral itself is more or less friable, the ex-"tremities of the branches, some of which were four feet high "above the sand, were easily reduced to powder. The parts "near or beneath the surface required some force to detach "them from the rock, from which they seemed to grow; I "have seen coral in many places at a distance from the sea; "but never before found any so high above the sea, or in so "perfect a state."

This is, without doubt, one of the most curious facts of this kind, and the most important to verify and study accurately. Can it then be believed that the two vessels of our expedition, the *Geographe* and the *Casuarina*, remained for almost a month at anchor in this very King-George's Bay, in a manner at the very foot of Mount Bald Head so interesting to examine, without any of the three naturalists, who were then aboard these vessels, being permitted to go ashore!

Happily the great island of Timor presented a field more vast and important still for observations on zoophites; there every thing attests their power and the revolutions operated by them in nature. They are found on the summits of the most lofty mountains in the vicinity of Coupang; in the deepest excavations, in the most extensive caverns, they exhibit themselves in the most unequivocal manner. In the very dangerous and difficult excursion which my friend Lesueur and I made to Olinama, we observed every where the same composition, at Oba, Lassiana, Meniki, Noebaki, Obello, Olinama. At this last place we found ourselves opposite the great chain of mountains of Amnfoa and Fatelou, of which the opposite side is uninhabitable on account of the enormous quantity of crocodiles which live in the marshes of this part of the coast; all this vast enclosure, which towers over this part of Timor, is entirely composed of madrepore materials. From Oeapa as far as Pacoula all is calcareous; the inhabitants say, and the Dutch unanimously confirm this fact.

It is not solely in the dead state that the zoophites at Timor excite admiration and interest; still living they occupy the whole of the bottom of the sea; in all parts of the Bay of Babao they raise up isles and reefs. The Island of Turtles

(Kea Poulu), that of Birds (Bourou Poulu) that of Apes (Code Poulu) are exclusively their work. The long moles of reefs which depart off from Simao Point more and more contract the entrance of the bay at this place. They render the coast of Fatoume and Soulama inaccessible; banks formed of their fragments accumulate every where. At the coast of Osapa one may walk at low water over three quarters of a league of the shore from the land abandoned by the tide. H re at ease may be enjoyed the marvellous spectacle of millions of these animalcules occupied incessantly in the formation of those rocks over which one walks; all the different species of them are assembled at the feet of the observer; they present all around him their singular and fantastical forms. The different modifications of their colours, of their organization, of their structure, excite in succession curiosity and reflection; and when they are examined with a powerful microscope, it is difficult to conceive how those feeble insects, with means in appearance so very small, could raise from the depths of the ocean those vast chains of mountains which are protracted over the surface of the island, and which seem to compose its entire substance. Timor appears to be one of the best places for examining the nature of those interesting animals: the calmness of the sea, its high temperature, the nature of the shore which is passable to great distances out at low water, as before observed, with water scarcely knee-deep; the prodigious number of those animals, their variety, all are favourable for researches of this kind. The small depth of water permits their contraction and their greatest expansion to be easily seen; there the progress of their increase and its termination may be observed; in a word there is no doubt that an examination of this nature, undertaken by some skilful naturalists, would contribute in the most effectual manner to the advancement of this branch of natural history, so little known, and of which the knowledge is so valuable.

We have seen those zoophites, both petrified and living, stationed in every part of that zone of the globe comprised between 34 degrees north and south, roughen the sea with reefs, form new islands, enlarge the ancient ones, and every where augment the land at the expence of the waters; we have seen their ancient works raised above the sea, towering to vast heights above their present level. This last phenomenon deserves some farther consideration. A double question presents itself here, Were those madrepore mountains elevated from the sea, or did the sea subside from them? In the first case we cannot conceive any other cause capable of raising such immense masses, but violent and multiplied volcanic eruptions.

But, independent of many other reasons which are in opposition to a cause of this kind, we well know that these

great convulsions of nature always leave after them indelibly traces of the disorder and destruction which exclusively characterise them. But nothing of this kind appears in the Madrepore regions. I allude to the regular forms and gradual degradation of these animal concretions in the island of Timor, which are the picture and the effect of the calm of nature. I have related the excellent observations of Vancouver, which are alone sufficient to demonstrate how gentle the cause must have been which left these branching madrepores uncovered, whether its action was gradual and slow, or rapid and instantaneous. Labillardiere has made similar observations. The two Forsters also report the most valuable facts on this head. And, finally, M. D. Fleurieu himself, after having related the opinion of the two English naturalists, thus expresses himself: "By which "of our common systems can we account for the origin of "that prodigious number of little islands, either scattered, "formed in groupes, or united like those of the Archipelago, "which, after the most exact examination, appear to be still on "the increase; these isles are met with fifteen hundred leagues "from the continent and from the great islands, in the midst "of a sea the depth of which the lead of the navigator could "never fathom. The attentive eye of the enlightened observer "can discover nothing in those low isles which attests the an- "cient existence, the remains, or the traces of volcanos ex- "tinguished, or buried beneath the sea; nothing which ex- "hibits a picture of ruins; nothing, finally, which can indicate "that they are the effect of any convulsion of the earth; every "thing announces, on the contrary, that they are the work of "ages; that this work is still continued, that it must occa- "sion a gradual increase to them, but that a long succession "of time is necessary to render this increase visible." Thus then the unanimous opinion of all observers, in repelling the opinion of their being of volcanic origin, overturns every idea that the land here could have elevated itself above the level of the sea. It follows as an immediate consequence from this, that it must have been the sea which has subsided below its ancient level.

Of different Species of Incrustations, and particularly of the incrusted Shells which are found in parts of New Holland.

The most irregular and curious incrustations are found in abundance on the coasts of the isle of Kangaroos, on those of St. Peter and St. Francis, and on the shore of the immense bay of Sea-dogs. There the trunks of shrubs are found entirely covered with a calcareous crust; in other places are heaped up branches of trees, roots, shells, zoophites, the bones of animals, the excrements of quadrupeds, all concealed by a similar covering. As the unfortunate Riche elegantly observed, on a

similar occasion: "One would be tempted to believe that a second Perseus had carried the head of Medusa along those distant shores."

At the sight of so many curious singularities, a desire to know the cause of them naturally occurs; and this is apparent in the nature of the particular kind of sand which is to be found on the coasts, which I shall here explain. The numerous shells which are produced in those seas, rolled incessantly by the action of the waves on the neighbouring shores, are by them broken into very minute fragments, which, becoming mixed with the quartose sand which is found at the brink of the sea, speedily constitutes with it the principle of calcareous cement of a superior quality. In examining with care these materials one is tempted to suppose that Mr. Higgins, in his excellent memoirs on calcareous cements, had drawn this secret from nature: in effect the propositions which he has mentioned as being capable of forming the most solid combinations, that is to say, one part of lime and seven parts of quartose sand, are those which nature seems to have adopted for this cement.

Whatever may be its particular composition, it is the only cause of those remarkable incrustations of which I have spoken. On the coast it soon incrusts all bodies which come within its influence; shells, pebbles, zoophites, all are cemented together by it: the observer sees, as it were, formed under his eyes, the brescias and pudding-stones, of which the neighbouring rocks are composed. This active matter, transported by the winds, deposits itself on the neighbouring shrubs; at first it is only a light dust, but it soon solidifies itself around the trunk which it encloses; from this moment the mode of nutrition of the vegetable alters; it soon languishes, and, though still living, it experiences a sort of general petrifaction. I have brought back many specimens of this sort, and would have brought many more, if the difficulty of transporting them had not prevented me.

What is the most extraordinary circumstance in this work of nature is, the celerity with which this species of metamorphose is effected. I have reason to believe, from my own observation, that in a month after it is thrown up on the shore a shell is no longer to be known. The force of the sun's rays, the vivacity of the light reflected by the white sands of the coast, are sufficient, with the water of the sea, to take from it all colour, and disorganise it in such a manner, that in the midst of the calcareous bed which surrounds it, the most experienced eye might mistake it, and rank it with the class of shells the most anciently petrified. From the different specimens of these kinds of alterations which I have exhibited, it may be judged how easy these mistakes are, and how impossible it is to assign

to most shells any character proper to distinguish those truely fossile.

Observations. — It is greatly to be hoped that M. Peron's strenuous recommendation of the zoophite polypi to the attention of the naturalists will have its proper effect; and that some of them will undertake that examination of their nature and habits which he advises, for which no place could be more proper than that he has pointed out. This examination may be of much more consequence to mankind than merely to complete an article in natural history, and give accuracy of detail, for classification, to those who content themselves with names and catalogues.

A careful study of the nature of any animal enables a judicious observer to direct their labours as he pleases. This dominion of man over the inferior creation has no limits that are as yet known; wherever the experiment has been made it has been uniformly successful. Beasts, birds, and insects, are alike subject to it; and there is no reason in nature why the same attention which has enabled man to direct the labour of bees (an animal apparently of the most refractory disposition) so that they shall form their combs in what position or place he chooses, should not be equally successful with the mild, unresisting polypi. In fact their habits seem, in some instances, the most favourable that could be desired for the important use which might be made of them, that shall now be mentioned; and for which purpose little more is wanting but to find out what circumstances induce them to continue their labours in one direction more than another, and to end them abruptly after extending them to a certain distance.

The polypi are observed to construct those rocks, which form their habitation and defence, mostly perpendicularly from the bottom of the sea, so that oftentimes a great depth of water is found close to them, and to run them out in long narrow courses, which form reefs of vast length and little comparative breadth. It is impossible to conceive any two propensities which they could have more favourable than those to the construction of piers, moles, and other defences for shipping; or to imagine a more desirable use to which to apply any natural power.

To effect this purpose, the principal difficulty is to discover a method of stopping their labours at pleasure, at least as far as regards direction. If the method of doing this should not appear evident, though it is most likely it will, from a more particular knowledge of their nature, it is, however, extremely probable that there are certain minerals, or perhaps even vegetable substances, which, lowered down on those parts of the bottom of the sea where it was desired their labours might terminate,

should at once have the proposed effect. Poor copper ore, or cupreous pyrites, which is to be had in abundance in many places for the labour of removing it, is extremely likely to produce this end, as all worms remove from it with precipitation, and a few tons of it might be sufficient for a great extent. As to making them work where required, nothing more seems necessary than to deposit a foundation of fragments of madrepore, full of the living insects, of sufficient size and weight to maintain their position for a time against the waves; these the insects would soon unite into a solid mass, and erect on it a fabric more durable than the most boasted works of man.

By this method harbours might not only be improved into any desired shape or form, but new ports might actually be created, of the most perfect design for safety, where none at present exist, and this in the whole of the great extent of 68 degrees adjoining the equator, which comprehends full one half of the navigable seas of our globe. Thus also islands might be united by causeways run from one to the other, and even new islands framed; and in this manner the very circumstance which now occasions the greatest dangers to navigators, as explained in the foregoing paper, might be converted into a means of safety for them, and permanent defence against the violence of the ocean.

And as fire, as well as the other powerful elements of nature, though most destructive when unrestrained, are our most serviceable agents when properly managed, so this operation of nature, so potent from its extent and magnitude, though now frequently productive of michief and terror, may be hereafter rendered the parent of safety and benefit alone; and those new countries which are by its means raised from the bottom of the ocean for mankind, instead of being as now, for the most part nearly inaccessible, may, at some future period, afford multiplied refuge and protection to the mariner from those tempests which they now arm with aggravated terror.

The part of the globe where this great operation of nature takes place, seems chosen by divine wisdom in the most favourable manner for man, not only in producing those new islands and countries for his residence, in climates extremely friendly to his support and salubrity, but even as it regards geological arrangement; for had those vast masses of matter been produced in the extra-tropical southern latitudes exclusively, and all this prodigious weight been accumulated at the southern pole, while the seas, and of course ponderous matter, diminished near the equator, there can be no doubt but it must considerably have altered the balance of the earth, and of course its position with regard to the sun; for the south pole, in consequence of the access of matter, would then be more attracted

by the sun than the north pole, which might have such an effect in altering the climate of the globe that the finest parts of Europe might experience all the rigours of Lapland, and mountains of ice exalt their barren tops where now are to be found the most fertile plains, abounding equally in inhabitants and every thing necessary for their support. But the only effect which an addition of weight can have in the part of the globe where this accumulation of matter actually takes place, is to alter, in a very small degree, after a great lapse of years, the time of the earth's diurnal revolution round its axis.

The part of this paper which relates to the petrifactions, or incrustations, formed on various matters, in the places and situations mentioned, is also worthy of attention, as some useful hints may be drawn from it relative to the formation of cements: perhaps a method might thence occur of forming lime with less heat than is at present used, and that the sea water might be found to have a beneficial effect in making it coalesce with other substances. Much might be learned on this head from other petrifactions, formed elsewhere in similar situations, though in a different manner; some very remarkable of this kind are to be found on the coast of Dublin Bay, near Dunleary, where not only the gravel of large masses, which have fallen into the sea from the adjacent cliffs, is united into a solid rock, but the very vegetable mold which forms part of them, is petrified equally hard, while in colour and shape it preserves still a perfect resemblance to that above it, of which it once formed a part, and which is equally soft and friable as any elsewhere. This petrifaction is the more remarkable as there is no lime to be found near it, nor does any accumulation of shells take place on the coast: the stone of the neighbourhood is a hard grey granite, but lead ore and other minerals are found at no great distance, and manganese has been discovered at low water in many places at the other side of the bay; this last, if the veins of it reach across, may perhaps have some influence in producing this effect.

It is to be hoped, however, that hereafter the real cause of this singular petrifaction may be better known; no where are to be found gentlemen better qualified to investigate any mineralogical question than in its vicinity; and perhaps this account of it may excite some of them to undertake the examination of this substance.

If a conjecture may be hazarded on this matter, there is probably some union takes place between the lime which is always found dissolved in sea water, (mostly in combination with muriatic acid), and some mineral, with which the soil is impregnated; which is imagined to be manganese, both be-

cause that species of lime which contains manganese is known to set hard under water, and that veins of this latter mineral are found in the same bay, as before observed.

Of a Meteoric Stone which fell in the vicinity of Sigena, in Arragon, in the year 1785, *and on this Species of Stone in general.*

By M. PROUST.—*Jour. Phys. Vol.* 60.

VERY few at the present time have any doubt that stones have fallen from the atmosphere on different parts of the earth. Antiquity has handed down to us accounts of this fact having often happened, and the ensuing ages have also recorded in their annals the periods and authenticated circumstances of many similar occurrences. In our days there have been collected in the East Indies, in America, in England, Scotland, France, Italy, and Hungary, many of those stones and minerals which are called meteoric: and, that there may be nothing wanting to give conviction to those who refuse their assent to the united testimony of ages, nature seems to have expressly directed the frequent repetition of this astonishing phenomenon. Very lately (in May, 1803,) at L'Aigle, in Normandy, a shower of these stones covered an extent of three quarters of a league long and half a league broad: and the National Institute immediately appointed a commissioner to examine, on the spot, the circumstances of this event, and to bring back specimens of the stones to Paris.

The president of the Royal Society at London, and other persons who preserved meteoric stones in their cabinets, sent portions of them to Mr. Howard, a member of that society, to analyse them, and class them according to the constituent principles which he might discover in them.

But how great was the astonishment of this chemist, when he perceived that those stones which had fallen on parts of the earth so far distant as Borneo in India, Scotland, Portugal, and Italy, were nevertheless composed of elements perfectly alike, with some small difference only in their proportions, and that to a singularity so unexpected they joined that of each containing, without exception, a portion of iron alloyed with nickel; a species of combination which the customary construction of every part of the earth, with which we are acquainted, excludes from being met with among the minerals it encloses.

The identity of these stones was confirmed, after the labours of Howard, by those of Vauquelin, who multiplied the proofs by finding in all the same elements, the same mode of combination, and the same characters.

An agreement so extraordinary between these stones, and also between the meteoric phenomena which accompanied their fall, led all the philosophers to suppose that bodies formed of the same materials, and endowed with the same properties, must have a common origin. But what is that origin? Do they belong to the earth on which they are thrown? Are they the produce of the atmosphere from whence they have fallen? Or, have they been exploded from the volcanoes of the moon, as far as our globe? These are questions which still furnish matter of argument to all the naturalists of Europe.

The Cabinet of Madrid possesses also one of these stones since the year 1773. His excellency the minister of state, persuaded that he ought to concur with all others in endeavouring to throw light on a fact of natural history so surprising, had the goodness to yield to my request of permitting it to be analysed. This stone of Sigena proves that an individual of this wonderful family fell in Spain only to multiply, by the identity of its elements with the others, the proofs of a phenomenon of which our reason has so long disputed the possibility.

We here copy the letter of the Captain-General of Saragossa who sent this stone to Don Manuel de Roda, Minister of State.

Letter.

"They speak in this town of an extraordinary event which "happened, the 17th of November last, in a cultivated field at "Sena, a village belonging to the district of Sigena.

"The heavens being perfectly calm, about mid-day a noise "was heard like an explosion of artillery, which was repeated "three times in succession, and which was followed by the fall "of a stone, which weighed nine pounds one ounce, at a small "distance from two labourers. One of them approached it, "but the strong scent which it exhaled stopped him for a mo- "ment. He again returned to it, took it up with his spade, "and waited till it was sufficiently cool to be carried to the "village, where he deposited it with the Curé.

"Information from the place where it fell, and from the "neighbouring parts, concurred in stating, that the noise and "fall of the stone was not accompanied either with a storm or "with lightning."

To unite in one place all that is now known relative to stones fallen in Spain, we here add a copy of the letter of the Bachelor Cibdadreal, relative to those which fell near the village of Roa, in the neighbourhood of Burgos, in the year 1438.

"The king, Don Juan, and his court, being engaged in hunt- "ing, near the village of Roa, the sun became hidden behind "white clouds, and there was seen to fall from the air grey and

"blackish stones, of a size so considerable, that they caused "the greatest surprise.

"After the space of an hour, during which this phenomenon "lasted, the sun re-appeared, and the falconers mounting their "horses immediately rode off to the place, which was not more "than half a league distant. They brought back word to the "king, that the whole field, where they were, was so covered "with stones of all sizes that the earth could not be seen.

"The king wished to go to the spot; but his court prevented "him, by remarking that a place which heaven had chosen for "the scene of its operations might not be safe, and that he had "better send there some of his suite.

"Gomez Bravo, the captain of the guards, undertook to go, "and brought four of the stones to Roa, whither the King had "retired. They were of a considerable bigness, some round, "of the size of a bomb, and others like pillows, and equal to "half a *fanega*, (a measure which holds about forty-five "pounds of corn); but that which caused the most wonder "was their excessive lightness, for the largest of them did not "weigh more than half a pound. They were so delicate that "they more resembled the froth of the sea petrified than any "other matter. They might be struck with the hand without "causing the least contusion, or pain, or leaving any mark. "The king ordered some of them to be sent to you," &c. &c.

It appears, from this description, that these last stones were very different in their nature from the others; and, although their great fragility leaves little hopes of finding any remains of them, yet, perhaps, if some of those who are curious in these matters, and happened to be near Roa, would make inquiries on the spot, some traces of them might be yet found.

The Stone of Sigena.

This stone weighed six pounds ten ounces when it was taken from the cabinet; a fragment of from three to four ounces, remaining of those which curious persons had broken from it, accompanied it. In its entire state, it exhibited an irregular ovoidal shape, of from 7 to 8 inches long, and from 4 to 5 broad. It had not, if the expression may be allowed, but two sides, the one flatted, much rounded at its edges, and depressed a little in the middle; the other was a three-sided pyramid, obtuse, with irregular faces, of which the top and the angles were greatly rounded. It had, like all the rest of this kind, a black vitreous crust, which made it appear, at first sight, as if it had been varnished with pitch; and its little thickness shewed that though the fire must have been very powerful which thus vitrified its surface, yet it could be but of momentary duration, since the metallic and sulphurous parts, which lie immediately

beneath its surface, have not had time to change their colour, or even to have their degrees of brightness altered.

It appears that all that have been yet known have been attended with the same singularity of arriving at the earth in a state so very hot that they could not be touched without burning the hands; but if the others may be judged of from that which I examined, I could never believe that their heat had been sufficient to render them luminous, or to merit the appellation of incandescence, which some naturalists have given it.

This stone of Sigena had all the porosity of an aggregation of sand, devoid of every kind of cement; so that the breath was easily blown through it, when a morsel of it was held between the teeth; it yielded no sparks to the steel; and I moreover think that the pyrites which it contained were incapable of yielding any, for reasons which shall be mentioned.

Its colour was the same as all the others, an uniform blackish grey; which is that of a black substance enlightened by a white one; the shade of an earthy body tinted by oxyd of iron with a minimum of oxygen. It consists of a sandy mass, formed of grains ovoidal and rounded, of which the largest did not exceed the size of hemp-seed, and between which were dispersed metallic and sulphurous particles possessing all their original brightness, and particularly with that slight appearance of nickel which Bournon remarked in the others. In examining the earthy grains with a microscope, it is discovered that far from having been shaped by the movement of water, as might be thought, they are, on the contrary, so many globules bristled with reflecting or crystalline points, which does not permit them to be confounded with sand.

Those which are globular have in general a depression on one side, which gives them the appearance of spheroids composed of crystalline elements, or of molecules disposed in a certain order, while their fracture by no means authorises this idea.

Analysis.

A fragment of this stone, about two inches in size, exposed in a covered crucible to a red heat for a quarter of an hour, was taken out entirely changed, the sandy globules were become of a darker grey, and the metallic grains were deprived of all their brilliancy; they were visibly oxyded to the same degree as iron which has served for the decomposition of water; which leads us to remark, that if the stone had received from the meteor a heat of the same duration, the metallic particles placed near the centre would have lost that freshness and brightness which characterised them; for the air which it imbibed, or which so easily penetrated it, would not have failed to have caused a like change. But the stone of Sigena had a

vitreous crust, nothing different from that which it might receive in our furnaces, and yet its interior particles remained in that unaltered unmixed state which is proper to those combinations which have never been exposed to fire. This result gives us, in some degree, a scale by which we can judge of the species of heat to which these stones were exposed.

Desiring to know the effect of the most active fire on the specimen, about two ounces of it were exposed to the fire of a forge about half an hour, which was sufficient time to fuse an assay of copper. When the crucible was removed from the fire the fragments were perfectly fused; there was produced a semi-vitreous mass, blackish and slightly porous, and which did not exhibit any appearance on the edges of the crucible of its having undergone any effervescence before it melted. Globules of iron were dispersed through it, which had not time to fall down, although a regulus of more than one hundred grains was formed at the bottom.

This regulus was not very fragile; it crumbled under the hammer, and its particles, difficult to separate, exhibited the appearance of fasciculi, which I judged to be crystallised by the inequality of their filaments. Sulphuric acid dissolved this iron with facility, and the hydrogen which was produced had that odour which characterises carbonaceous cast-iron, but had nothing sulphurous in it. The sulphur of the pyrites being employed, without doubt, in disoxyding a part of the iron which the stone contained, had been dissipated in the form of sulphurous acid, in like manner as happens in the phenomenon of minium brought back to the metallic state by sulphur, of which Morveau has given us the theory. The vitreous mass was not sensibly attacked by the acid, which shewed that the silex, magnesia, and oxyd, were in just proportion for their respective saturation.

Of the Iron contained.

The particles which the magnet separated were too small to permit their shape to be seen accurately with the microscope; however, they seemed to be octohedral: they were not mixed very equally through the stone, for I extracted of them sometimes 17, sometimes 19, and sometimes 22 per cent.: to obtain them very pure, and without rust, I separated them from the sandy parts by using alcohol instead of water; but still the latter retained some of them, because the blows of the pestle united some of both together. One hundred grains of this iron infused in muriatic acid left five of sand, which supposes about seven parts of the stone, because the acid would dissolve its oxyds and magnesia.

This iron, submitted to the blow-pipe, did not exhale any odour; it dissolved like other iron, and the hydrogen produced

did not contain any sulphur, since this gas did not make the least mark on paper written on with a solution of silver; besides, its solution in nitrous acid did not trouble that of barites, which shews that the iron which the magnet separated from the stone of Sigena did not contain any sulphur.

Of the Nickel.

I only found this metal united to the particles which I shall now mention, and not at all in the stoney part, or in the sulphuret.

One hundred grains of these particles dissolved in muriatic acid, were mixed with a little nitric acid, which carried off the iron oxyded to a maximum, but not the nickel. This latter, although it is susceptible of oxydation to a maximum, like manganese and cobalt, has too great an affinity for the acids to permit the nitric acid to raise its oxydation above a minimum, when it is in union with an acid.

The solution was precipitated by ammonia, that the oxyd of iron might be had separately; mixed with a little potash, it produced sections of a rhomboidal prism, of a beautiful green, of the weight of twenty-four grains; and as one hundred parts of the mixture of nickel and potash contains twelve parts of metal, it is evident that twenty-four grains contain about three.

The nickel is neither oxyded nor united to sulphur in this stone, but only in alloy with iron, and it is this alloy which the magnet separates from the stone reduced to powder. As to the oxyd of iron, to which this stone owes its grey colour, it is mixed with oxyd of manganese, as is usual in many other stoney compounds.

M. Proust relates in this paper the various processes by which he estimated the other component parts of this stone; but these being similar to the modes of analysis with which all chemical gentlemen of any information are well acquainted, and which are detailed at large in several eminent works, need not be repeated; the result is stated as follows by M. Proust:

"We can from all this form the following table of the component parts of this stone, which will, however, be only *an approximation to exact statement, on account of the difficulty of rigorous valuations in practical analysis.* I did not think it right to place in this table the iron which the magnet separated, since it is only interposed in the substance of the stone as metallic veins are in their beds, and was always analysed apart when it could be separated mechanically.

Sulphuret of iron at a minimum	12
Black oxyd of iron	5
Silex	66
Magnesia	20
Lime and manganese, some atoms	—
	103

In comparing these meteoric stones with the minerals of this globe, a strong analogy will be perceived in their structure and composition, which would not have escaped the naturalists who have studied them, if too great eagerness to search for their origin in the regions of the marvellous had not led them astray from the right road.

There is no impossibility nor improbability that these stones, which do not appear in any known parts of the earth, may yet belong to some of those with which we are not yet acquainted, or which, perhaps, we may never be able to approach. Is it not right, for example, that before going to search for their origin in the atmosphere, or in the mountains of the moon, the possibility of their belonging to that vast portion of the earth which surrounds the poles, should be considered; and, that the meteors, of which we know neither the origin nor the combustibles which nourish them, nor the impulse which moves them, nor the nature of the lines which they trace, should be at least as well calculated to detach them from some parts of the globe as to form them, contrary to every physical probability, of elements which the atmosphere can neither create, nor hold in solution.

The result of my analysis gives the following lights relative to these stones—

The external vitreous crust could only be formed by a sudden heat of short continuance, which was most probably produced by the meteor with which they were carried; but, at whatever time of their existence those globes are considered, which an accumulation of electric fluid has precipitated in fragments, we know well, that they could not have produced such minerals by the sole force of ignition, since the nature and combination of their elements, the arrangement of these combinations, and the internal organisation of these stones, are in every aspect and consideration repugnant to this cause, and have nothing which exhibits the smallest resemblance to volcanic productions.

We must then consider these minerals in two distinct situations, in the first of which they lay at rest in their beds, (I shall not pretend to determine in what place or for what time); but at least in a system of bodies, far from having as their habitual temperature a heat capable of degrading their structure. The second is that, in which, torn from their beds by some violent cause, they traversed the atmosphere enveloped in an unknown meteor, which communicated to them its movement, and which sustained them contrary to the tendency of their own weight, and which never has been known to part with them, without imprinting on them the distinct mark of an electric explosion in their vitrified surfaces.

One of these meteoric stones, exposed to the open air, suffers degradation from the oxydation of its metallic particles, as rapidly as a piece of polished iron, and this degradation renders

numbers of those stones, which have fallen on the earth, undistinguishable from the ferruginous stones which abound on the surface of the globe.

From all these facts, we may conclude that the place whence these stones came, had neither, for its usual temperature, a heat sufficient to fuse their surfaces, nor experienced those transitions from moisture to dryness, which take place in the temperate regions of the globe; and that, far from having been produced at the instant of their fall, it is much more consonant to the principles of natural philosophy, to be of opinion that these minerals existed before the violent cause which removed them from their inert state, and that their species is as ancient as any of those which compose the rest of this globe.

Observations.—In the foregoing paper, M. Proust has very well refuted the strange idea that these stones were formed by some combination of the primitive elements of matter in the atmosphere; to which no process we are acquainted with affords the smallest analogy; no combination of gases or vapours having been ever made to produce a solid insoluble substance; or any combination whatsoever, at a single and instantaneous operation, having ever afforded a substance compounded of so many heterogeneous particles.

His objection to their having been exploded from the moon, is by no means equally well supported; his only reason for which seems to be founded on a pre-conçeived impossibility of the fact, without sufficient examination, which might have been ultimately caused by the custom, common in this part of the world, of using as epithets of absurdity, folly, or impossibility, terms derived from the name of this luminary.

There is no cause in nature to limit the power of explosion; nor can we say, that the prodigious force, which some philosophers have, with Dr. Darwin, attributed to it, of being competent to rend asunder whole worlds, and scatter their fragments into infinite space, is superior to what is conceivable, or contrary to any known law of nature. And if we attribute the origin of these stones to a volcanic explosion from the moon, in preference to one from the sun, or from one of the stars, it is only because the force required would be less, in the first case, and that the body exploded would be more likely to come to our globe from its proximity to that planet, and not from the greater distance increasing the difficulty so as to make it border on impossibility. The means which M. Proust proposes as a cause for the transportation of these stones is, on the contrary, loaded with improbabilities and contradictions to known principles. A meteor is first of all to descend, and, like an eagle sousing down on its prey, dart through the mass of ice

at the Pole, tear up these minerals from their beds, ascend again in a contrary direction; then again alter its course to a third line, and fly towards the equator, on its passage to which it suddenly explodes and lets them drop: this is nearly M. Proust's opinion; but even supposing the meteor to take its origin beneath the mineral, and dart into the atmosphere with it at once, still the same difficulty of penetrating the vast thickness of ice, and of accounting for the change of direction of motion, must subsist.

There is, indeed, a bare possibility of some of those stones having been thrown from volcanos on our earth, as shall be here explained; but many of them fell in places to which these could not have impelled them.

Suppose a stone exploded from Ætna, with a force sufficient to elevate it a space equal to four semi-diameters of the globe above its surface; at this distance from the earth a circle drawn from the same centre, would have five times the extent of the circumference of our earth, and each degree of this great circle would contain 300 miles; when the stone parted from the earth it would partake of the motion of the earth, as well as that which impelled it upwards, and would, therefore, move from west to east at the rate of 15 degrees of the earth in an hour, or 900 miles; now suppose the stone to arrive at the height mentioned in one hour, Mount Ætna in that time would be removed 15 degrees east, and the stone would have then traversed in a diagonal line, compounded of the two motions, 900 miles eastward, beyond the point of the great circle which was perpendicular to Ætna at the instant of this explosion; but this point is only three degrees on the great circle removed from the then place of the stone; consequently if the stone could be conveyed back in one instant, in a perpendicular line to the earth, it would only arrive at a place three degrees or 180 miles east of the aërial line in which it parted, but in this time Ætna would have moved 900 miles east; consequently the stone would fall in this case 720 miles west of Ætna, or, supposing it took a second hour to descend, it would then fall, from the same principles, at the very lowest computation, 900 miles west of Ætna; but in reality much more: for, as the earth in that time would move 15 degrees more farther east, and though the stone would also move 900 miles in the same time, yet the difference of extent of the degrees of the circles through which it must pass in its descent, above those of the earth, must make it lose something of its easting in the descent also, though not so much as in the ascent.

In this way we can account for the fall of a stone any where west of a volcano in the same latitude; but, as we know of no cause which could make the stone move north or south of the line in which it ascended; this method of accounting for the fall of stones from the atmosphere is entirely inadequate to

determine the origin of those which fell any where north or south of the latitude of some volcano, or of a line drawn round the earth, circularly through the volcano, and parallel to the equator, which is the same thing.

What has been said of the supposed stone losing, in the time of its ascent and descent, its easting, or falling west of the spot from which it rose, does not depend on mere abstract reasoning; the principle is confirmed by an actual experiment, well known to all philosophical gentlemen, in which a weight let fall from a few hundred feet above the surface of the ground, was found a space westward of the perpendicular, commensurable to the time of descent. But this principle, as before-mentioned, is inadequate to account for the fall of several of those stones; and therefore, as a cause applicable universally, the explosion from lunar volcanos must still be reckoned the best mode of determining this matter, and is, at least, full as probable as any other.

M. Proust's observation (that "the difficulty of forming rigorous valuations in practical analysis, is so great as only to "permit him to make an approximation to exact statement," in his table of the analysis of the stone of Sigena), gives us a valuable lesson in what light we should consider those wonderfully exact statements of analysis, which note thousandth parts of grains; and on the proportions of which, algebraical calculations are formed, with as little apparent doubt as on facts mathematically demonstrable.

If algebra can ever be of any use to chemistry, (which is extremely doubtful), its application is at least premature in analysis, at present; when one of the first-rate chemists confesses, that all he can do, aided as he is by the most extensive knowledge on the subject, the most critical judgment, and penetrating genius, is to form "an approximation to exact statement."

A Comparison of the Power of the common Mill Water-Wheel, with that of the Circulating Chain of Buckets, applied to the same purpose, by M. Francini, in 1668, *showing the superiority of the latter.—Rep. Arts,* No. 39.

By Mr. J. W. Boswell.

In 1668, M. Francini erected an engine, in the garden of the library of the king of France, in which a fall of water, acting on a chain of buckets passing round a drum-wheel, caused the wheel to turn round, by a power equal to the preponderance of the full buckets of the chain, at one side, over the empty buckets at the other. The object of this communication is to compare

the power of this apparatus in turning a wheel for mill-work, with that of the common mill water-wheel. To facilitate the comparison, the chain of buckets is supposed to be applied to turn round a wheel of equal diameter to the mill water wheel, over which it passes, after going round two smaller drum-wheels, one placed on a level with the top of the large wheel, and so much before it as to permit the chain of buckets to fall clear of it, and the other directly perpendicularly under the first, and on a level with the bottom of the large wheel: the water is also supposed to fall from the same height, in both methods; the buckets to be of the same size, and equally near to each other, and the mill-water wheel to be of the over-shot kind (which is esteemed the most powerful). From this arrangement, the length of the full part of the chain of buckets, will be equal to the diameter of the mill water-wheel; while the part of the mill water-wheel buckets, which must be filled in succession to make any one part of it pass through the same perpendicular space, will be equal to half its circumference. This half-circumference being supposed to be divided into two equal quadrants, the water in the buckets of the upper quadrant, when filled, will, from its position, have its centre of gravity nearly over the middle of the horizontal radius, and will consequently operate with but half the weight it would have, if appended to the extremity of the same radius; and of the water of the lower quadrant one half will be lost by leakage, and of the remainder, the operative weight will be greatly diminished from the same cause as that in the upper quadrant; from these circumstances it is a very moderate estimate to state, that the operative power of the water on the common mill-wheel, does not exceed half the weight of the quantity consumed. In Francini's engine, on the other hand, the power will be equal to the whole weight of the perpendicular chain of full buckets of water, operating at right angles at the extremity of the radii of the large wheel.

The consumption of water of the mill water-wheel may, from what precedes, be estimated as the semi-circumference of a circle (or as eleven), and the operative power of the water as the quadrant (or $5\frac{1}{2}$), and for Francini's engine, the consumption of water may be estimated as the diameter of the same circle (or as seven), and the operative power of the water as the same diameter (or as seven also): therefore the common mill water-wheel, with four elevenths more water, will produce three elevenths less effect than Francini's engine; which, on the whole, will be about seven elevenths in favour of Francini's engine: or in other words, Francini's engine, with equal consumption of water, will perform seven elevenths more work.

From this calculation M. Francini's method of giving motion to water-mills, is justly stated to be very valuable: and that it

highly deserves to be fairly tried by any one who possesses a water-mill with a limited supply, whose power he wishes to increase.

Method of forming a Pigment, having all the properties of Indian Ink. By the Author of the foregoing Paper.—Rep. Arts, No. 36.—New Series.

Take soap-maker's lixivium (or other caustic alkali in solution), make it boil on the fire, and add as much horn shavings as it will dissolve; when the lixivium is saturated with the animal matter, put in no more, but continue it on the fire after all moisture is evaporated, stirring it with an iron rod till the mass assumes a sort of fusion, and feels like a paste under the rod; for this latter part of the operation, a strong heat is necessary. Then remove the matter from the fire and throw it into water, about double the quantity of the original lixivium, stir it well, and let it dissolve for some hours. Then filter the liquor from the insoluble matter (by slips of linen laid over the edge of the vessel which holds it), and a clear liquor will be obtained. Into this clear liquor drop a solution of alum by degrees, and a black precipitate will be thrown down, which, separated from the fluid, dried, and then ground with gum-water, produces a black pigment, possessing the same transparency of colour, and capable of producing the same variety of shades as Indian ink.

The depth of the colour is injured by too much alum, care should be taken, therefore, to put in no more than merely sufficient to throw down the black precipitate. It is probable that vitriolic acid would have the same effect as the alum, without the same risk.

It is a singlar circumstance in this process that a liquor, holding so much carbonaceous matter in solution, should be so clear, and gives reason to suppose, that carbon may be contained in liquors not supposed to hold any, and that it may be made more soluble in water than is generally imagined.

REVIEW OF SPECIFICATIONS OF PATENTS.

In our First Number an account was given of the Specifications of Patents published in the course of the first four months of this year, in the Repertory of Arts, &c.; in which work they are accurately copied from the records in Chancery with engravings of the drawings. We shall now describe sixteen others, which have appeared in the same publication during the ensuing four months,—May, June, July, and August.

Mr. James Barrett's *Patent for Improvements in the Construction of Malt-Kilns. Dated Jan.* 1805.

The improvements in malt-kilns, for which this patent was obtained, consist principally of four separate articles, the first of which relates to means of regulating the fire to any required degree, of admitting heated air to the malt, and of preventing the absorption of heat by the walls of the kiln; which are all judicious applications of the inventions of Count Rumford, for the general improvement of fire-places, to the particular exigencies of malt-kilns, as Mr. Barrett candidly acknowledges.

The second consists of a contrivance for closing the superior aperture of the kiln to any required degree.

The third is a moveable furnace running on wheels, which may be set in a kiln for drying either pale or brown malt, but is mentioned as principally intended for the former.

The fourth is a contrivance for admitting the use of common pit-coal, in drying malt, mentioned by Mr. Barrett as chiefly applicable to the moveable furnace; but which could, no doubt, be equally well used with a fixed furnace.

The fire is regulated in Mr. Barrett's kiln by dampers, which close the passages which admit air to the fire as required, and these are so connected by chains and pullies with the regulator of the opening for admitting fuel (through which the air can pass to the malt without going through the fire), that the closing of one occasions a proportional opening of the other; a plate of iron lies directly over the fire, at a considerable distance above it, and admitting a free passage round it on every side, whose office is to prevent the heat from striking intensely in one spot, and to distribute it more equally under the whole wire, hair-cloth, or tiles, for sustaining the malt, which last are recommended to be supported by a frame made of narrow iron bars, crossing so as to

form small squares, or to be what Mr. Barrett calls an iron hurdle, which he says, has particular advantages for drying brown malt.

A number of small apertures, communicating with air tubes, which circulate round the neck of the kiln, are made both above and below the drying frame; dampers are fixed in the air tubes in such a manner that the air, heated by passing round the neck of the kiln, can be made either to pass out above or below the malt at pleasure: this contrivance, Mr. Barrett says, effectually carries off the great quantity of steam which is generated in drying the malt: and is particularly serviceable in the process of drying pale malt: the extremities of the above passages are closed with iron lattice to hinder vermin from entering.

To prevent the absorption of heat, the walls of the kiln are built hollow, or with hollow passages in them at every side; the floor of the ash-pit, and the whole area on which the kiln stands, is laid on arches for the same purpose.

The regulator for closing the upper part of the kiln consists of four sheet-iron quadrants, which turning on pivots in the line of the middle radius of each, in such manner that when in a horizontal position they form a completely close disk, which stops the whole of the aperture, and when in a vertical position they leave it entirely open: in all intermediate positions, they leave a passage for the heated air to pass out proportionate to their degree of inclination, and, when so placed, resemble much the flyers of a smoke-jack; a wire passes from each quadrant a little way down and hooks to another wire or chain, common to all four, which passes down to the front of the fire-place, and by pulling which the workmen can close the upper aperture to any degree he chooses; it may be easily conceived how, on letting go the wire, the quadrant could be contrived to open, by having weights so fixed to them, as to make them preponderate at one side of their centres of motion.

This regulator will at once extinguish all accidental fires in the kiln; will economize heat in preventing the access of cold air downwards on the malt when the drying first commences, (which will be particularly useful in drying pale malt); and, by being closed, when the kiln is not in use, will protect the kiln-wire, or hair-cloth, from damage by the weather, or soil from birds.

The moveable furnace is of an oblong shape, and is constructed with a fire-chamber, and ash-pit, with doors and registers in the same manner as a chemical furnace; there is a damper annexed to it, so contrived that, by moving it to a certain degree, a new passage is opened for the fire into the iron flue next to be described, and the direct passage to the malt closed.

The use of this iron flue (which forms the fourth principal contrivance), is to permit the burning of common coal for heating the kiln, when culm or coke cannot easily be had. It consists of a flue of cast-iron, through which the smoke passes into a chimney, around which another tube is made to pass spirally, one extremity

of which communicates with the space beneath the frame for sustaining the malt, and the other is connected with pipes passing through the body of the fire, (or where they will receive considerable heat from it) to the external air. By this means the air is heated so, in circulating round the iron flue, as to dry the malt effectually, and at the same time be totally separated from the smoke.

Mr. Barrett recommends the use of iron in the formation of the cowl, of the internal doors, and of the window-frames, as being not liable to warp or shrink, and free from danger of burning.

Besides these contrivances, Mr. Barrett mentions two doors of iron or earthen-ware, moveable at pleasure, placed at each side at the farther end of the neck of the kiln; to equalize the flame arising from wood, in drying brown malt; which seems to be particularly useful, as Mr. Barrett says this object cannot be obtained by any skill or labour of the workman, in kilns of the old construction, but of which he has unfortunately given no accurate description either as to their size, position, or management.

Observations.—This kiln of Mr. Barrett's seems to be one of the most complete yet constructed, and to possess every requisite for regulating the fire, preventing accidents, directing the draught through the kiln to any required degree, economizing the fuel, and admitting of a greater variety of it, facilitating the management of the kiln, and rendering this business safe and free from distress to the workman. Mr. Barrett mentions the moveable fire-place, as if it possessed peculiar advantages, but, as he has not described what these are, we must only rely on his opinion in this particular; as there is no very obvious reason why it should be better than a fixed fire-place.

Mr. Barrett has had the candour to acknowledge the assistance received from the inventions and publications of Count Rumford, in the construction of his kiln; but this does in no wise diminish his merit in the judicious application of them to the purposes desired; for it oftentimes requires no less ingenuity to direct a former invention to suit a new purpose, than originally to plan it.

Mr. JAMES FUSSELL's *Patent for improved methods of working Water-Wheels, raising Water, and preventing Water-Wheels from being flooded. Dated June* 1803.

THE specification of this patent states four separate mechanical operations, to which it is meant to apply. The two first and principal of them are very ancient though valuable inventions, one of which is for raising water by a chain of buckets, circulating round a drum-wheel, which delivers the water at the top of the wheel in succession, as its motion raises them: the other is the reverse of this, and consists of another chain of buckets, of larger

size, circulating round the same drum-wheel, into which a stream of water, falling at the height of the top of the wheel, fills them as they pass; and their weight, when thus filled, causes the drum-wheel to turn round, and thereby raises the water, by the chain of smaller buckets (before mentioned) from a greater depth; the drum-wheel is also mentioned, as it turns round, to be intended to work two levers by cranks, which levers are to work pumps. This last, we apprehend, cannot be designed to be set forth as a new invention, being extremely common.

The third consists of an application of the old contrivance used in Holland, and some of the fenny counties in England, for raising water to a small height by the action of a wheel, constructed in the same manner as an undershot mill-wheel, but with deeper water-boards, which is generally turned by a windmill; but Mr. Fusell directs this to be put in motion by a water-wheel for the purpose of forcing off the back water, from the water-wheel of a mill in time of floods.

The fourth contrivance is, a species of horizontal windmill-wheel, with sails at right angles to its plane; a moveable case surrounds one half of the wheel, which is always kept so as to skreen one half of it from the wind, and leave the other half exposed to its action, by a large vane which forces round the case as the wind shifts; but unfortunately, this is also an old invention.

Observations.—The plan here mentioned, for raising water by a chain of buckets, is one of the oldest inventions in existence, as has been before stated in the account of Mr. Bates's patent, in our first Number, notwithstanding which, and its having been always in common use both in Asia and the Continent of Europe, this is the third patent wherein it has been claimed as a new invention.

The contrivance for turning round a wheel by a chain of buckets filled in succession by a stream of water, running at a level with the top of the wheel, is, perhaps, nearly as old as the other; but, for a more particular account of this invention, its powers, value, and antiquity, we refer to another paper in this Number on this very subject by Mr. Boswell, containing a comparison between the powers of the common mill water-wheel, and those of an engine on this last principle, constructed by Mons. Francini, in the garden of the library of the king of France, in the year 1668, shewing the great superiority of the latter.

It is very possible, however, that Mr. Fusell might not have known that M. Francini erected precisely such an engine as is delineated in his specification at the time mentioned, though it is accurately described, with a very good plate, in Dr. Desaguilier's Natural Philosophy.

There may be something new in the application of the old fen-wheel for clearing the tail-fall of water-mills from back water. There is, however, no merit of this sort, in the horizontal windmill mentioned in the specification, as two of this kind were erected a few years ago at Dublin, one for clearing the foundations

of some of the works about the new Custom-House from water, the other for effecting the same purpose for a dock, excavated by the Royal Canal Company; and both performed so badly, that the horse mills which were added to them, with the intention of occasional application in calm weather, were finally the only movers used.

Mr. BARKER CHIFNEY's *Patent for a Composition to be used in Washing, in order to render Muslins and Linens beautifully White. Dated September* 1804.

MR. CHIFNEY directs, for his *new-invented* composition, that any quantity of sub-carbonate of potash or of soda from one to six parts be infused in twelve parts, or thereabouts, of water, or water saturated with lime, and that there be added to this alkaline liquid, when hot in the copper, any quantity of common soap, from four to seven parts, "or more," sliced or macerated, so as best to form a compound with it, of the consistence of cream, butter, tallow, or ordinary soap: when the compound is sufficiently mixed, it is either let to cool in the copper, while constantly stirred, or transferred into another vessel for the same process. Mr. Chifney observes, that the strength of the composition depends on the purity of the alkali used; and that he prefers taking away the sediment of the alkali and lime water when mixed, although he is not certain its remaining would have any bad effect.

Observations.—It is difficult to conjecture what is the precise object of this patent; surely Mr. Chifney cannot intend to monopolize the use of soda or potash, in washing either separately or with soap, which have been used for years for this purpose. We should imagine it was the mixture of the former articles with lime-water, that he intended to secure to himself, if he had not declared that common water was equally efficacious, by directing the use of either indiscriminately. How this gentleman can suppose the use of sub-carbonate of potash, or soda (which is but another name for the soda and potash, now sold for washing in every oil-shop), with or without soap, to be a new invention for cleansing or whitening linens, is altogether inexplicable.

It might be thought that his object was to sell the mixture in a solid form; if he had not declared that it was equally convenient of the consistence of cream; or that some certain proportions of the ingredients had a superior effect, of which he thought he was entitled to the sole use, if he had not left to all the proportions the very wide limits which have been already mentioned.

Mr. John Jones's *Patent for a Liquor for printing and dying Cotton, Linen, and Woollen. Dated January* 1805.

Mr Jones directs, that vinegar, pyrolignous or wood, sorrel, tartarous, or any other vegetable acid, should be saturated with lime, "or any other calcareous earth," then left to settle; and after that poured off clear, then when heated over the fire, that there should be added to it as much vitriolic, nitric, or marine salt of lead as "will separate the whole of the oily or bituminous or extractive parts," that the mixture should be again poured off when clear, and that there should be then added to it as much alum or copperas as will separate the lime and lead. The liquor thus produced will be that for which this patent was obtained.

Observations.—In order to understand the nature of the printing liquor described, it is necessary to consider the effects of the different mixtures in succession; first, the calcareous earth (by which carbonate of lime must be intended) mixed with the pyrolignous acid, will take up that acid, and give out fixed air, a small proportion of the carbonate and pyrolignate of lime will be dissolved in the liquor, the rest fall to the bottom, and the clear liquor will consist of pyrolignous acid, having a considerable quantity of fixed air, or carbonic acid, mixed with it along with the before-mentioned carbonates in solution. The addition of any of the mineral salts of lead, afterwards directed, for example the vitriolic, will throw down the lime in the form of gypsum, and set free the pyrolignous acid it held in combustion, which will then unite to the lead; and the liquor will then consist of carbono-pyroli nous acid with pyrolignate of lead in solution; the lime or vitriolic acid that will remain in the liquor will be in such very small quantity as not to require notice.

The next addition directed of alum or copperas will have different effects, according to which of them is used; if the copperas be used, an iron liquor might be formed or pyrolignate of iron, if the vitriolic acid will quit the iron of the copperas to unite to the lead, and leave the iron united to the pyroli nous acid; but this is very doubtful.

As for that procured by the addition of the alum, its principal use must be for fixing colours already put on, or as a mordant; for its operation on the fore-mentioned liquor will be to form a copious precipitate of vitriol of lead and argil in conjunction, and leave the liquor to consist of carbono-pyrolignous acid, with a small proportion of argil, or pyrolignate of argil in solution; for as the at-

traction of pyrolignous acid to the argil is generally reckoned very weak, it is not probable that much of it should be formed; but even this small proportion mixed with the pyrolignous acid, may have uses for fixing particular colours, of which dyers alone can estimate the value.

Mr. BELL's *Patent for making Moulds to manufacture Knife, Razor, and Scissar Blades, various Edge Tools, Forks, Files, and Nails. Dated March* 1805.

THE moulds mentioned in the title of this patent consist of certain impressions cut into steel or cast-iron rollers; which rollers are fixed so to correspond with other rollers, that a heated bar of metal passed between them shall assume the intended shape, by being forced into the cavities of the rollers, by their motion round.

Mr. Bell very properly states that the object of his patent is the peculiar figures or impressions cut on the faces of his rollers; for the invention of forming articles into particular shapes by passing them under figured rollers can claim no novelty, and any merit of it will have to be divided with several other patentees.

For the description of his rollers, Mr. Bell refers principally to the figures in his drawings; one of them viewed endways presents the figure of a serrated (or ratchet) wheel. It is easy to conceive that a flat bar, will, by being passed under this roller, with a due compression, be formed into a number of oblong pieces, thick at the back, and gradually tapering to the edge.

Another roller is cut the reverse way of this first, its cavities continue all round, and form a number of circular grooves, deep at one side, and gradually sloping upwards to the surface; a flat bar rolled under this roller will be also formed into a number of pieces, of the same shape as the others before mentioned, but of a much greater length, and by it may also be shaped into lengths sloping from the upper extremity towards the point, as well as from the back to the edge, by having the circular cut less deep at one side of the roller than another, and gradually sloping round from the deepest part to the shallowest.

The rollers described are the only ones of which drawings are given; the figures on the surfaces of the others wanted may easily be imagined from these.

Mr. Bell declares his principal object is to manufacture copper sprigs, or nails, by these rollers, previous to heading.

Mr. JOSEPH HUDDART's *Patent for a new Method of spinning Yarn. Dated September* 1804.

MR. HUDDART's method of spinning consists of one the reverse of that used by rope-makers; in theirs the twisting machinery is stationary, and the man who gives out the hemp moves; in Mr. Huddart's the twisting machinery moves on, as the thread is formed, and the man who gives out the hemp or flax is stationary.

For this purpose it is directed that a large band should communicate with a roller in the moveable frame, after passing over stationary wheels at each end of the building, or spinning ground; one of these wheels, turned by men or horses, will give motion, by the band, to the said roller, which turns the spindles that twist the yarn, and also turns two of the wheels on which the frame is supported, so as to give it progressive motion. The hemp or flax is directed to be laid out on a table, furnished with an instrument to hold it, the same as a flax-dresser's hackle, by which the patentee conceives great advantage will be obtained in delivering the hemp even and regular, without any crossing of its fibres but what is occasioned by the twist.

Observations.—The only part of this invention that seems of much utility is the last article, relative to the mode of delivering the hemp from a hackle.

It is an established law in mechanism, that the parts of least weight should have the motion given to them in preference to those more ponderous. Mr. Huddart does not state any advantage to be gained by reversing this rule, and occasioning a great expence for additional labour to put those parts in motion which are usually fixed, and the most heavy about the apparatus.

As to the mode of delivering the hemp or flax, it is conceived a light frame might be easily contrived to hold the flax in some manner over a hackle, and either be carried by the spinner, or drawn by him, as he moved along in the usual manner, which would have every advantage of the other method, without the additional labour and complication.

Mr. JOHN LEWIS's *Patent for a Means of preventing Accidents in Wheel Carriages. Dated February* 1802.

THE specification of this patent describes three contrivances for preventing accidents to carriages.

The first is a method of disengaging the horses from the carriage at pleasure; to effect this, a sort of catches are contrived, which secure firmly in their places the extremities of all the

traces, back-bands, and other straps, which connect the horses with the carriage, as long as they are untouched; but which has each a spring bolt so fixed, that on drawing it in one direction, the strap is instantly disengaged from it: small chains or wires run from each of these bolts, and finally unite in one chain, which running over a pulley, or connected with a crank or quadrant to alter its direction, passes into the carriage, to the handle; which, on being pulled, of course draws all the bolts, and disengaging every connection of the horses to the carriage, separates them effectually: where necessary, the direction of each separate chain or wire is altered by a pulley, or crank, in similar manner to that of the principal chain which communicates motion to them all. It is easy to conceive how these principles may be applied to carriages of different constructions.

The second contrivance, applicable to all carriages, is a ratchet-wheel with a catch, commanded by a wire or chain, in somewhat similar manner to that already described, on pulling which the catch falls into the ratchet and prevents its turning but in one direction: one of these ratchet-wheels is to be made fast to each wheel of the carriage, by which it may be prevented from running down hill, when the horses are disengaged, or prevented from pressing on the horses in a similar situation

The third contrivance is intended for two-wheel carriages; it consists of a sort of prop, united by a hinge, either to the fore or back part of the carriage, and is sustained out of the way by a spring catch under the carriage; from this catch a wire or chain passes, and unites with those, already described, for disengaging the horses, by which means, on the handle before mentioned being pulled, at the same instant in which the horses are disengaged, the prop falls down, and prevents the carriage from pitching over.

As two-wheeled carriages are hung so very far back at present, Mr. Lewis recommends that one of these props should be used at the back part of the carriage as well as at the front; he directs that a light wheel, six or eight inches diameter, should be placed at the lower extremity of each prop, to prevent their breaking from a too sudden stop of the motion when let down; and that a spring should be fixed to each, both to accelerate its fall, and retain it in its place when down, for which latter purpose a serrated catch, or ratchet, is also fixed to it, which presses against the axle, or some other fixed post, when the prop is down.

Observations.—The Society of Arts have offered, and, we believe, given, more than one premium for inventions for preventing accidents in carriages, which may be seen described in their Transactions: the principle must be nearly the same in all; but those here described seem to be as simple and efficacious as any yet made public, except that for which Mr. J. Williams obtained a patent. (See Rep. Arts, Vol. I. New Series.)

Two-wheeled carriages are much more liable to danger than four-wheeled, and depend more on the horses: no contrivance can absolutely ensure safety in them when the horse is unruly: at present they are made so very slight, that the least accident breaks them; the shafts particularly are much too weak in all: their seats are also generally hung too far back. It is a mistake to think that this eases the horse; if the weight were thrown forward so as to let him bear a moderate proportion of it, he would move easier, particularly in bad roads, and up hills; and also, as can be demonstrated, would have his power of draught increased, while at the same time the carriage would be rendered much more safe by this arrangement.

A contrivance, which has already been adopted in a few instances, would make the shafts much less liable to break, without increasing their weight. In this method they are joined, each by a strong hinge to the carriage, from the under part of which a spring projects beneath each shaft, to the extremity of which it is secured, either by a small brace, or iron loop, fastened to it a few inches before the hinge; this not only prevents the shafts breaking by the yielding of the springs, but also in a great degree renders the jolting motion of the horse less perceptible.

Mr. JOHN JOWETT's *Patent for a Fire-Guard, to add to Stoves, or Grates, to prevent Accidents by Fire. Dated May* 1804.

THE fire-guard consists of a semi-cylindrical skreen of metal, either close or grated, which is contrived to draw out laterally from the side of the fire-place, and cover it entirely; this skreen passes through an oblong aperture in the side of the stove, so as to be hid behind the grate when not wanted; in its motion outwards it is sustained in a vertical position, by two horizontal bars, joined by hinges to the middle of the back of the fire-place, which are each of the length of the radius of the semi-cylindrical skreen. These bars the patentee calls "lever-cranks."

Mr. Jowett mentions that there may be one of these skreens fixed to each side of the fire-place, and made to meet in the middle, if preferred to a single fire-guard.

Observations.—A patent was obtained in America by Messrs. Charles and R. Peale, for a sliding skreen to let down before the fire from above, and draw up again behind the mantle, like a sash-window, and balanced by weights in like manner (a description of which is published in the Repertory of Arts, Vol. II. New Series); this appears to have the superior advantage of regulating the draught of the chimney, and the temperature of the apartment:

where these latter circumstances are not regarded, there is no reason why Mr. Jowett's skreen should not be as effectual as the other; and where the front wall of the chimney is thin, or there is not room in the chimney to admit the other kind of skreen to ascend, no doubt Mr. Jowett's would be preferable, as it occupies no more room than the stove, and requires no alteration of the brick-work over the mantle or elsewhere, as the other in many cases would.

Mr. JONATHAN HORNBLOWER *s Patent for a new-invented Steam-Wheel. Dated March* 1805.

THIS engine consists of three principal parts:—

1st. The external circular case, which is shaped like a globe, from which about forty degrees are cut off at each pole.

2d. A partition which divides this case into two parts transversely in the plane of its axis, which shall be particularly described.

And, 3d. The moveable or circulating parts, which are analogous to the piston in the common steam-engine. To form an idea of these last, we must conceive a hollow nave attached to an horizontal axle, which nave is pierced with two pair of circular holes on its cylindrical surface, each pair corresponding at opposite sides to each other; through these holes pass radii moveable round their own axis for one-half a circuit, to these radii are attached flat quadrants, placed so that the planes of those at opposite sides of the nave should be at right angles to each other, by which means (as those two are in fact on the same axis, which traverses the nave, and projects at opposite sides), when one of them is placed so as that its plane shall be at right angles to the axis of the nave, the plane of the other will coincide with that of the said axis.

In the partition before mentioned are two cavities at opposite sides of the centre, one of which corresponds exactly to the shape of the greatest surface of the quadrant; the other is much smaller, and only admits the quadrant edgeways; these cavities are continued in a sort of case of the same shape, for one-fourth of the circle each side, by which means there are always two of the quadrants, or the greatest part of them, working in each cavity at the same time.

The quadrants are made hollow so as to admit of being stuffed at their edges; and the cavities of the partition are so contrived as to be stuffed also, as is likewise the space round the nave, in which it circulates, and that in which its axis moves.

It may now be easily conceived, that the external circular case is divided by the partition and the quadrantular pistons, into two separate chambers, each steam-tight; into one of these chambers

a pipe is conveyed from the boiler, and from the other chamber another pipe communicates with the condenser; now as the quadrant which occupies the greater cavity of the partition opposes a much greater surface to the pressure of the steam than that which lies edgeways in the smaller cavity, of course it will be forced forward toward the cold chamber, into which when it is arrived, it meets a sloping block, so shaped, that in passing it, it is turned round one quarter, or so as to be at right angles to its former position, and thus enters the smaller cavities edgeways, while by the same movement the opposite quadrant is turned flat across the entrance of the larger cavity of the partition, and on entering it, is impelled in its turn by the steam, as before described.

The axis, or arbor, on which the nave is fixed, which sustains the quadrants, or vanes, passes through the outer case in an horizontal direction, and to its extremities are to be fixed those wheels which are to give motion to the machinery required to be worked by the steam-wheel. The outer case is fixed in a vertical position, and has a flat plate cast at the part intended to be lowest, by which it may be bolted to the floor of the building in which it is erected; it is formed so as to separate into three horizontal sections, the middle one of which is for the purpose of admitting and properly fastening the partition with its stuffing boxes: the upper section serves as a lid, and all are secured to each other by flanches and screws.

The steam is admitted into the lower chamber of the case, and the condensing pipe passes from the upper chamber.

Observations.—It is a very great object to contrive a steam-engine, with equal power to those in use, on such a principle as to act with a continued motion in one direction. In engines which work with alternately reversed movements, the whole mass of matter put in motion requires a new impulse equal to its whole weight, at every reverse of direction, (if balanced, or moving in a horizontal direction) or equal to double its weight when ascending, if moving vertically, and not balanced; but in continued movements in one direction, such as that of the circumference of a turning-wheel, the mass of matter requires but *one* impulse equal to the weight, and all that it needs afterwards to continue its motion is sufficient impulse to overcome the friction at its axle, and the resistance of the air.

This fact Mr. Hornblower has adverted to in his specification, and there is no doubt that if his steam-wheel could be made to work without any drawback to the advantage it has of moving in one direction, that it would be preferable to every steam-engine yet constructed; but it is possible that the force necessarily lost in the steam-wheel, from other causes, may be full as great as that lost in the common engine from reversed motion, and in this case the common engine will be preferable to it, on account of its greater simplicity, and being less liable to go out of order.

In Mr. Hornblower's steam-wheel, force will be lost equal to the pressure of the steam on the surface of the transverse section, or thickness of his vanes or quadrants, (as it is only by the excess of the pressure on the greater surface of their flat sides, that this machine moves); and force will be also lost in the great increase of friction which there is in it more than in a common steam-engine, arising from the much greater quantity of rough surface exposed to contact between the moving and the fixed parts, in proportion to the extent of the part of the vane, or piston, which receives the impulse of the steam. By the rough surface it is intended to denote the surface of the stuffing, which acts in proportion to its extent as a resister to motion, not merely by its roughness, but also by the elasticity of its materials, which occasions a resisting pressure, commensurable to its extent of contact.

To make the stuffed parts steam-tight in the steam-wheel would also be extremely difficult, on account of the great proportional extent of them, and the inequality of their shape; and this would be particularly the case in the parts where the vanes, or quadrants, came in contact with the nave; it would also be much more difficult to keep it in order than a common engine from this circumstance.

But whether these disadvantages will counterbalance those of a common engine arising from reversed motion, or exceed them, can only be determined satisfactorily by actual experiment of one of each sort worked in opposition, in which, for each, the consumption of fuel should be equal, and the boilers and condensers of equal size; but every other part constructed in each so as to produce the greatest possible effect in its favour.

The waste of force, in a common steam-engine, from reversed motion, may be made much less than it usually is, by constructing all the parts subject to this motion as light as possible, and omitting those that can be spared.

The great balance beam, for instance, may, in all cases be omitted in double engines, (which should be the only kind ever used) and in most cases in single engines also; numbers have been constructed for effecting rotary movements without the beam, which perform extremely well; and the same might be done in those for pumping also, by merely reversing the position of the great cylinder, and placing the piston-rod, which would then descend before the cylinder, directly over the pump-rod.

Besides the description of the steam-wheel, Mr. Hornblower mentions, in his specification, a method of forming the teeth of mill-wheels, so that they shall have all the advantage of small teeth in diminished friction, and be sufficiently strong at the same time; this consists in shaping them so that, instead of lying strait across the edge of the wheel, as they usually do, they may each be inflected so as to form an angle in the middle, every angle pointing the same way, which will produce a figure, Mr. H. observes, similar to the Cheveron of Heraldry.

Some eminent mathematicians have calculated the exact curves which the faces of mill-wheel teeth should have to roll over each other without friction; something has been published on this subject by a gentleman of much learning, of this country, which probably will, hereafter, be communicated in this Work. At present it is sufficient to mention, that a French mathematician of consideration proposed for this purpose, that the teeth of one wheel should be cut each with a cycloidal face, and those of the other, which worked against it, with flat faces.

WILLIAM BARON VAN DOORNIK's *Patent for a Composition of certain Earths and other Ingredients for washing. Dated December* 1804.

THE following is the Baron's direction for forming the above composition. Take a sufficient quantity of marl or saponaceous earth, (probably fullers earth) as free from mixture as possible, dry it in a kiln, and reduce it to a fine powder, by grinding and sifting, after which, if thought fit, it may be exposed to the air, to improve its colour or qualities, in form of cakes or otherwise.

To make a ton weight of the detergent composition, or soap, for general use, take 690 pounds of tallow, fat, or oil, and by the ordinary process proceed to convert it into soap; when this is nearly converted into soap, pour into it a mixture of 410 pounds, or thereabouts, of the aforesaid prepared earth, with an equal quantity of strong lees, prepared by previously boiling them together three or four hours, during which they should be constantly stirred; both being mixed together hot, the whole should be brought to a "gluey," or liquid state, by pouring into it 290 pounds weight of the lees, or thereabouts, then keep the whole gently stirring and boiling for about an hour, and after this pour it into frames, and leave it to cool till the next day, when it may be cut up with wires, like common soap.

For coarser purposes, the mixture is directed to be 430 pounds of tallow or oil, converted into soap, with 630 pounds of the earth, and the same quantity of lees, prepared as before mentioned, to which, when united, should be poured 290 pounds more lees, and the whole afterwards managed as already directed.

Observations.—The possibility of the union of alkali with earth has been proved to exist in the composition of the phonolithe or klingstein, which contains a twelfth part of soda, united to alumine, silex, and a small portion of lime, for the most part of its component substances; and in that of feldspath, which contains potash; this

gives some reason to believe that the prepared earth directed in the above composition, may really have a power of converting the additional quantity of lees, or caustic alkaline solution, mentioned, into soap, in conjunction with that of the tallow or oil in the soap directed to be mixed with it. If so, no doubt this is a valuable discovery, from the saving it would occasion, in soap-making, of the tallow, which is the most expensive article used in it; and even if this composition could be only applied to washing coarse articles, it would still be proportionally useful; but experiment alone can ascertain how far it may be used to advantage in washing different articles, and where it differs from common soap in its effects. It is imagined it would be of a more caustic nature, and that if the earth were not carefully freed from the sand, or silex, with which it is always found mixed more or less, the detergent composition would be too rough to be used with safety for fine linens or muslins.

Mr. WILLIAM HAWKS*'s Patent for improved methods of constructing Chains for the use of Mines and other purposes. Dated July,* 1804.

THE object of this patent principally relates to implements for and methods of fabricating the chain.

The chain which is made by Mr. Hawks, is of the same kind, on a large scale, as the very minute chain used in watches between the spring cylinder and the fusee wheel, and formed like it of flat plates united by pins or rivets.

The implements for making the different parts of the chain consist of steel moulds and dies for cutting out the links (by the force of a screw engine), all of the same shape and size; and others carrying punches at proper intervals for cutting out the holes in these links, through which the connecting pins are to pass; other moulds and dies are used for forming and fixing on perforated bushes to these links, which project a little at each side of each link; these bushes consist at first of a pipe and shoulder, the pipe is passed through the link up to the shoulder, and then another mould is forced by the screw engine down on the part of the pipe which passes beyond the link, and compresses it into the same form as the shoulder at the other side; when the links are thus formed, all equal and perfect in every respect, they are united by the pins in any number in a row which is thought proper, or the strength which the chain should have requires.

Observations.—The implements above directed for making the links and the method of using them, though their application to making the chain may be new, have no other novelty

to boast of, for they are altogether similar to what has been in use for like purposes in Birmingham, Sheffield, and in other parts of England, for many years, and by means of which the manufacturers of hard-ware have been enabled to make their goods cheaper than those in other countries.

The very fine watch-chains, before mentioned, as well as can be recollected, have their links formed by cutting them off from larger pieces previously drilled, and shaped by moulds and guages.

And when implements so very similar have been in use for making chain, whose only difference from what the patentee designs to make, consists in its small size, it is extremely hard to draw the precise line of even the novelty of application in this instance.

There is no doubt, however, that the chain would be perfectly even made in this way, and would, in all probability, from this circumstance bear a greater strain than those made merely by hand.

Mr. JACOB BUFFINGTON*'s Patent for a Method of Straining or Stretching Woollen Cloth for Shearing, and for Straining all other kinds of Piece Goods. Dated October,* 1804.

Mr. Buffington thus describes the object of his patent:

To strain cloth or other stuffs, the lists of the cloth are to be secured to one edge of strong web by lacing or otherwise: the other edge of the web is made fast to a small rope or cord that passes through apertures in frames, so made as to suffer the web to pass freely when moved backwards and forwards, and to prevent the rope from drawing out in the act of straining.

The principal object, he declares, of this plan is to strain the cloth from list to list, by which he says the workman can perform better work in less time than if it was fixed in any other way.

The small rope does not lace the web to the frame, as might be imagined from the above description, but is merely fastened to its edge so as to prevent its slipping through little wooden implements that fasten it to the habiting frame, which are something similar to hand-vices, and tightened by screws in the same manner.

Mr. GEORGE ALEXANDER BOND*'s Patent for Improvements in the Construction of Clocks, &c. Dated March,* 1805.

THE specification of this patent relates chiefly to a different method of forming the dial-plates of clocks from that in

common use; in Mr. Bond's method the dial is to be of some transparent substance, and the figure of an opaque substance, so that a lamp or candle placed behind the dial shall, at night, render the hour visible to those who look at the plate.

Mr. Bond mentions some different methods for fixing the light conveniently behind the plate; one of which is to lengthen the axis which supports the hands, so as to allow the dial to be brought forward a sufficient space before the work of the clock, to admit of room for the light between the work and the dial.

Mr. Bond mentions that semi-transparent substances may be also used for dials in his method. Mr. Bond also notices a method of making dials by forming the enamel distinct from the metal plate and afterwards uniting them by cement, which will render them more smooth and perfect.

Observations.—This invention of Mr. Bond's will be principally of use for public clocks erected in churches and elsewhere. For clocks in houses it would not be very necessary, as it is extremely easy to illuminate their dials sufficiently by placing a light in a proper position near them. It is apprehended also, that the smoke of the lamp or candle would be injurious to the clock-work in Mr. Bond's method, and that the additional apparatus which it would require to prevent this injury taking place, and the risk there would be of breaking the glass dials in placing and trimming the lights, would furnish arguments sufficient to induce a preference of having the light outside, and using common dials, for house clocks at least: by a simple reflector the light of a lamp at one side of the clock may be thrown sufficiently strongly on the dial to make the hour perfectly visible without in the least interrupting the view.

Mr. CHARLES FREDERICK MOLLERSTEN's *Patent for a Composition to render Leather, Woollen Cloth, Linen, and other Stuffs Water-proof, impenetrable to hot and corroding Liquors, &c. giving them a fine gloss, preserving them from decay, and keeping them soft and pliable. Dated Jan.* 1805.

To prepare the composition of a black colour, Mr. Mollersten gives the following directions:

"Take two gallons of linseed oil, one gallon of whale oil, half a pound of horse grease, mingle them with four pounds of finely ground Prussian blue, and four pounds of lamp-black, and afterwards boil them over a strong fire; to which add one pound of fine ground benzoin gum, previously well mingled in one gallon of linseed oil, of which one half gallon is to be put

in the above, when the composition has boiled half an hour, and the remainder when the boiling is finished. This composition is sufficiently boiled when it gets so thick *that no drops fall from any thing dipped into it*; and it is afterwards fit for use when cold.

"For making the composition of other colours. The genuine linseed oil must be well bleached: to two gallons of which put half a gallon of spermaceti oil, and half a pound of Prussian blue, place them in a glass vessel in a strong sun (the effect may be increased by burning-glasses if necessary), and when they have attained the same consistency as the black composition, after having boiled one half hour, take one pound of benzoin gum mixed with one gallon of linseed oil bleached, add one half of it to them and place the same in the sun, as before; and, when it has again attained the same consistency as the black composition, add the remaining half of the gum and oil."

Mr. Mollersten recommends that the colours used should be at least one half of metallic compositions, as he is not certain that colours composed of animal substances only will answer the purpose: he also observes, that the Prussian blue mixed with the other colours renders the substances on which they are put *capable of resisting heat and corrosive liquors*, though without it they will resist wet equally well.

Mr. Mollersten directs the composition to be laid very thin at first, on the substances to which it is to be applied, and that *scraping irons* be used for this purpose.

The substances are then to be stretched on a board or frame over blanketing, and put into an oven to dry the composition, and this operation is to be repeated till the substances have attained the proper gloss and smoothness; besides the scrapers pumice-stone is to be used in the intervals of drying, to make the surfaces smooth and even: from four to six repetitions of the lackering and drying will generally complete the process.

Observations.—One of the directions for boiling the composition should not be followed too exactly, or the whole composition will probably be spoiled, that is, "*to boil it till no drops fall from any thing dipped into it*;" this is one of those extremely vague rules which those who are well acquainted with a process frequently give, from not considering that those they desire to instruct are not sufficiently acquainted with such operations to know that they mean by such phrases any thing but the literal sense. The direction would probably be nearer the truth if it was, that the matter should be boiled till it adhered to any thing dipped into it; or till the whole of the matter adhering to any thing dipped into it did not again fall off in drops.

Mr. James Tate's *Patent for Friction-Wheels on a New Construction. Dated June* 1802.

These friction-wheels are intended principally for the use of carriages, and are to be added above the axle, which is to turn round beneath them.

Each of them consists of a concave wheel (like a cup), with the cavity downwards, joined to a perpendicular spindle, which turns in a frame above the axle of the carriage-wheels; the carriage-axle has a shoulder, or projecting circle, turned on it, on which the edge of the concave friction-wheel rests; and the carriage-axle is kept in its proper position, under the friction-wheel, either by staples passing up to the frame-work, or by two common vertical friction-wheels placed properly beneath it; the spindle of the concave wheel has its upper extremity hollowed into a cup to hold oil, into which a pin screws down, by the point of which the weight is supported; the lower end of the spindle is pointed, and turns in a cup of oil likewise, which is supported by the frame; the friction-wheel and the part of the axle which turns under it, with the apparatus for keeping the latter in its place, are all surrounded by a case to keep off the dust.

As the axle-trees themselves must turn round, it is not absolutely necessary that the carriage-wheels should turn on them also; but Mr. Tate thinks it best they should do so, because in going down steep hills it might be necessary to stop the axle from turning altogether (by letting a catch fall down upon it), and leaving the carriage-wheels to move round the axle in the common manner, in order to prevent the too great velocity with which the carriage would be otherwise apt to run down the hill, from the friction being so greatly diminished.

Observatione.—The chief object of this invention is to make the whole weight bear on the points of perpendicular spindles, instead of horizontal axles; and there is no doubt when these points, and the sockets they bear against, are made of very hard and unyielding materials, that the friction will be greatly diminished by this means, notwithstanding the lateral friction which must be against the side of the sockets of the upright spindles, and of the concave wheel against that of the circular projection of the carriage-axle on which it bears.

The perpendicular position of the spindles gives the farther advantage of having their extremities run in cups of oil; which, from their horizontal situation, retain the oil in the simplest

manner, without requiring any of the complicated contrivances, or exact fitting of parts, and consequent binding and pressure, which is used in giving the same benefit to horizontal axles.

There is a farther advantage in the use of friction-wheels to carriages, of which probably Mr. Tate is not aware, which is, that the carriage-axles, to which they are applied, being necessarily perfectly *straight*, (as they must turn round also,) will make it impossible to fix the wheels in that position so very injurious both to the draught and the road, which is customary, and whose bad effects in those respects have been so ably pointed out, and so clearly demonstrated, in the very excellent treatise on this subject, published by Mr. Cummings, (for which see Rep. of Arts, Vol. 13, 2d Series). As wheels are now fixed, their shoeing, or iron rims, form sections of cones, which, as the inner part of each next the carriage consists of a larger circle than the outer part, must of course turn on the road with unequal velocity in those parts; which grinds the surface of the road, forces its materials from the middle towards the sides, and proportionally retards the draught of the horses, a very considerable portion of which is lost in overcoming those unnecessary and destructive resistances. But where friction-wheels are used, as the carriage-axles must be straight, the wheels of course, on the same axtle-tree, will each have every part of its circumference at an equal distance from that of the opposite wheel, and not, as in the present fashion, be much nearer at their lower parts than at their tops; the rims of those wheels will, therefore, be cylindrical, and will, from this circumstance, move on the road with less injury to it, and less draught.

As the principal impediments to the motion of carriages arise from the imperfection of roads, and the bad position of the wheels just mentioned, which both together may, at a fair estimate, amount to 99 parts out of 100 of the whole; and as the obstruction from the mere friction of the wheel on the axle cannot be estimated at much more than a hundredth part, it would seem that, in common roads, it would be a matter of small consequence to lessen this friction, or even to remove it entirely, when so large a part of the other impediments remain without remedy; but, for carriages which are to run on iron-rail roads, particularly those roads which are on a level, Mr. Tate's invention promises to be of great utility, for on such roads, the friction of the axles forms a much greater proportion of the impediment to motion, than on common roads, as on iron-rail roads the other impediments are removed to perhaps as great a degree as is possible.

But, in carriages to run on common roads, the greatest improvement that can be made, is to fix the wheels so that the planes of their circumferences shall be at right angles to circles

perfectly straight, and their rims cylindrical: if the friction on the axles were totally removed, it would not occasion near so much advantage; and the chief benefit which any kind of friction-wheels occasion, will arise from the making such a position and construction of the axles necessary, as must cause the carriage-wheels to be formed in the manner before explained.

The strength said to be given to a carriage-wheel by the dishing form, could be much more effectually and indubitably given, by fixing the spokes alternately in different circles on the nave, in the same manner as the mail-coach wheels were all at first constructed, and are still in most cases; and wheels could be thus formed to run on straight axles, with superior strength to the dishing wheels, together with the other advantages pointed out. It may not be improper to observe here, that the farther asunder the circles are on the naves, along which the spokes are fixed, the stronger will the wheels be.

The great facility which Mr. Tate's invention gives for retaining the oil, may make its use in carriages for common roads an object of considerable importance, particularly for carriages that are intended to run with much velocity, such as mail-coaches and stages; and there is reason to think, that for them this circumstance would be of much more importance than the diminution of friction in other respects.

For such carriages the simplest form of Mr. Tate's friction-wheel would be best; and, therefore, a single friction-wheel and staple at each place of support would be preferable for them. The friction-wheel may be made so as to rest on a single point in one oil-cup, by enclosing the upper part of the spindle in a socket, the lower oil-cup and its support would then be useless, and might be omitted, which would make the contrivance more simple: if the friction-wheel were also fixed so as that its plane might incline a few degrees to the horizon, and thus, in some degree, rest on the back part of the axle; when the carriage was put in motion, it is imagined this position would enable it to diminish the friction on the back part of the axle, arising from the draught, as well as that on its upper surface proceeding from the weight.

Mr. Cox Stevens's *Patent for New Constructions of Boilers for Steam-Engines. Dated May* 1805.

Mr. Stevens states, in the preface to his specification, that from experiments made in France in 1790, by M. Belancour, it was found that within a certain range the elasticity of steam was doubled by every addition of temperature equal to 30 degrees of Fahrenheit's thermometer, which experiments were carried as far as 280 degrees.

Mr. Stevens also states, that his father made experiments on the same subject, and found, that at the temperature of boiling oil, which has been estimated at about 600 degrees, the elasticity of steam was equal to the pressure of forty times that of the atmosphere.

Mr. Stevens's application of this principle, for which he claims the exclusive use, consists in forming a boiler by means of a system or combination of small vessels, instead of using a single boiler as is now customary; this method, *any way* applied, Mr. Stevens claims, but states the particular form which he thinks best for this purpose as follows:

"Suppose a plate of brass, of one foot square, in which a "number of holes are perforated; into each of which is fixed "one end of a copper tube about an inch diameter, and two "feet long, and the other end of the tubes to be inserted in a "similar piece of brass. The tubes, to insure their tightness, "to be cast in the plates. The plates are to be enclosed "at each end by a strong cap of brass or cast-iron, so as to "leave a space of an inch or two hollow, between the plate and "the cap; the caps are to be fastened to the plates by screw-"bolts. The supply of water to be forced by a forcing-pump "into the cap at one end, and the steam to pass through a tube "from the other end of the cap to the cylinder; the whole is "then to be set in brick-work in the usual manner, and placed "either horizontally or perpendicularly."

Observations.—The object of the form of boiler described, is to expose as great a surface as possible to the action of the fire; but there is no vacant place left in it to serve as a steam-reservoir, which is usual in all steam-engine boilers, and without which it is most probable the supply of steam would be very unequal.

It is a question of law to determine whether Mr. Stevens has a right to prevent any one from using more than two boilers at once to an engine; but, as it appears, from his own statement, that the intent of his contrivance is for working engines under a *great pressure of steam* from a very great heat, it does not seem that his patent could apply to prevent the use of a number of small boilers on the common construction, worked at the usual low pressure, which, as they might all be made of cast-iron, and could be re-placed singly, if damaged, without disturbing the others, would probably be of some considerable use; especially as there is no way yet discovered of making large boilers of cast-iron, so as to be worked with advantage, as is evident from their not being used.

The principle mentioned in Mr. Stevens's preface, "of doubling the pressure of steam by every addition of 30 degrees of temperature," is not so indubitably advantageous as he and some

other gentlemen seem to think; for unless they can prove, that in order to produce this increase of temperature, there is not *an increased quantity of fuel used in proportion to the pressure of steam produced*, the advantage must be still doubtful; and as the increased pressure of steam depends solely on the additional quantity of caloric or fire, combined with it, it seems more than probable that a quantity of fuel must be used at least in an equally great proportion to this increased pressure of the steam.

Steam-engines worked under great increased pressure of steam are more difficult to be kept steam-tight than those at a moderate pressure, and are very liable to dangerous accidents from different causes, the most obvious of which is their bursting from the direct pressure of the steam.

But they are also liable to be burst from another cause, which is not known to the general class of engine-makers; when metals, particularly iron, are heated to a certain degree in contact with water or steam, the water is decomposed, its oxygen converts the metal to an oxyd, and its hydrogen enters nto the gaseous state; hydrogen in contact with oxygen, (wihch will be furnished by the atmospheric air, which all water holds in solution in considerable quantities) explodes most violently either by a certain heat, or even a certain degree of pressure, both which it experiences in the boiler: so that engines on this plan seem like a fabrication of gunpowder over a naked fire, to those who know this circumstance. Mr. Stevens's boiler seems particularly liable to this last accident; a combination of metallic pipes, exposed to a strong heat, is the very apparatus which chemists use for the gasification of fluids on certain occasions (one of which, contrived by M. Baruel, is described in this Number); and such is the construction of the above boiler, as to answer this description so exactly in every respect, that it would probably form as complete a gasifying apparatus as any experimental chymist could desire.

It is extremely probable that most of the violent accidents which have happened to engines working under high pressure, and with great heat (some of which have been attended with fatal consequences) have arisen from explosion caused by the gasification of water in contact with highly heated metal; and that even the lesser accidents that occur, such as forcing out the cocks, &c. from the boiler, (some of which have been known to be driven off with that violence as to penetrate the roof as if shot from a gun) have also proceeded from the same cause.

Any circumstance that may occasion explosion is the more to be dreaded in steam-engines, as safety-valves afford no cer-

tain defence against this accident; for if the explosion is any way violent, the bursting forth of the ignited gas takes place with such extreme velocity, that no moderate sized valve can give it sufficient vent, or even yield to it with necessary quickness.

Conjectures on the Causes of the Diminution of the Waters of the Sea. By M. POIRET.—*Jour. de Phys. Vol.* 60.

THE immense quantity of marine productions which are found petrified on Mount Perdu, in the Pyrenees, at three thousand yards height above the level of the sea, is to most people an incontestable proof of the prodigious elevation of the ocean above its present bed at some remote period, and of its continuation at that height.

This great truth has now obtained the most rigorous demonstration; but the human mind cannot be content with this solely; it demands, with eager curiosity, *What has been the cause of so great a diminution of the ocean?* This gives rise to infinite conjectures, and each adopts that opinion which he thinks most probable, or which is most conformable to his favourite system.

Some suppose this was caused by the sinking down of the mountains, or by their elevation; others believe that the waters could be changed into air or earth; others that they remain suspended in the atmosphere; some think that they have concealed themselves in the heart of the globe; and, finally, there are those who maintain that they have passed off to other globes.

This grand question always appeared to me one of the most essential relative to every system of geology: I have therefore endeavoured to solve it in my turn, by following attentively the operations of nature which daily take place on the surface of our earth.

As long as water was thought to be an unalterable element, which was restored to its original form entirely on the decomposition of the animals and vegetables of which it formed a part, the consequences from this---that it must always exist in nearly the same quantity at the surface of our globe, occasioned the difficulty of accounting for its known diminution, which made it necessary to suppose the existence of immense reservoirs for its reception in the bosom of the earth, or its passage to other planets, in which hypotheses, so contrary to

the laws of natural philosophy, the imagination was confounded.

But since we have acquired the knowledge of the compound nature of water from the beautiful experiments of Cavendish and of Lavoisier, and understood the qualities of that hydrogen and oxygen of which it is composed; the cause of its diminution almost spontaneously presented itself, since in not being a simple substance, it could no longer be considered as indestructible: hence it must now be classed among those compound substances whose existence is of course only temporary, and which are subject to a destruction more or less rapid according to the nature of the agents which attack it.

Water enters into the composition of most substances in nature, as an elementary principle, particularly in those of animals and vegetables; but if it unites to some without losing its nature, it cannot unite to others but by being decomposed and ceasing to be water. It is thus that it abandons its oxygen to iron, and its hydrogen to plants. These two principles once separated cannot unite again to form water but by a concurrence of circumstances which does not often take place.

This principle of decomposition of water being once established, we have only to consider what substances, absorbing it most, by their great multiplication can occasion a sensible diminution of the aqueous element; none appears more qualified for this great operation than vegetables and animals. I will commence with the action of the first, and afterwards consider the effect produced by animals, minerals, and the other phenomena, which can accelerate the decomposition of water.

The necessity of water for the production and growth of plants is too well known to need proof. It is not less evident that *one part of the water absorbed by plants remains in its natural state, and that another part more considerable is decomposed.*

This last portion requires some explanation;—the water absorbed by plants becomes one of the principles of their nutrition, and consequently of their growth. In this view, it cannot remain in them in its natural state; it experiences the same action which aliments do in the stomachs of animals; it is digested by them, if I may use the expression, and although it may be difficult to explain how this is done, we have good proofs of the fact from the effects produced, and the new chemical discoveries also assist much in letting us see some of those secret and mysterious operations of nature.

It is true that a certain quantity of water remains unmixed in the plant, as the *sap*, which is frequently but a pure limpid water; and another portion holds in solution other substances, as the *juice*, which varies according to the nature of the plant: in fine, water is found in all parts of plants in greater or less quantity.

But if a portion of water remains thus in the plant in its natural

state, a still greater quantity is actually decomposed, becomes a constituent part of the plant, and is converted by the vital pores of the plant into vegetable substance, as fruit and roots are converted into flesh by the digestion of animals. Hydrogen is one of the principles of water, we find it in oils combined with carbon, we find it in the state of gas in the decomposition of plants, and experiment has demonstrated that leaves exposed to the action of the sun absorb hydrogen from water with considerable force, and give its oxygen to the atmosphere. The quantity of water which plants assimilate thus, is so great that Hales found that a plant which weighed three pounds had acquired an augmentation of two pounds, after remaining for some time with its roots in water.

What then becomes of this great quantity of water which plants absorb?

The solution of this question is decisive. It is certain that the two pound mentioned does not remain in a state of water in combination, since if the plant does not receive more water it perishes in a few days. It may be said that this water escapes in the form of vapour by the secretions; but none of the experiments made on the transpiration of plants favour this opinion: that plants yield only elastic gases from their different parts, such as oxygen carbonic acid, azote, and sometimes hydrogen, according to circumstances, is well known; here then is the evidence of the decomposition of two pounds of water; and what thus took place in a single experiment passes continually in the wonderful operation of vegetation.

The solution of this last question leads to another: *Does a sufficient quantity of water enter into the composition of vegetables to account, at least in part, for the great diminution of the waters of the ocean?*

The experiment of Hales, and many others, shew us the great quantity of water which is consumed by plants; on the other hand, plants in this operation only retain the hydrogen, which is but a seventh part of the water.; if then the plant requires 100 measures, of any kind, of hydrogen for its daily support, 700 measures of water must be absorbed to produce it. Suppose then that a tree during the time of its vigorous vegetation, or during 100 days in the year, consumed each day a pint of water, and that this tree lived 40 years, it would have decomposed in that time 4000 pints of water, or about eight hogsheads. This estimate, though considerable, is doubtless very inferior to the reality. If, however, we apply this calculation to all plants existing on the face of the earth, if we add to this the idea of a vegetation existing for thousands of ages, and of those immense forests which still cover the uninhabited parts of the world, and which once covered the countries now cultivated; if in fine we consider that the whole mass of vegetable earth, the extensive depths of

peat, and the thick beds of coal, are all so many remains of ancient vegetation, what an idea must we have of the enormous quantity of water necessary for the formation of all these substances, and for the support of such an abundant vegetation for so long a period? But it is not sufficient to prove that water is decomposed in the act of vegetation, and becomes one of the constituent principles of plants; we could conclude nothing in favour of the diminution of the water, if we could not likewise prove, that

Plants either in their customary transpiration or at the time of their decomposition, do not restore, or at least in but a small degree, that principle of the water, the hydrogen, which they separated from it.

I have remarked that in the numerous experiments which have been made on the transpiration of plants, the gases exhaled by the secretions of vegetables, were oxygen, azote, or carbonic acid, and scarcely any appearance of hydrogen, though it ought to be the most abundant.

This gas appears only in the decomposition of plants; it is produced in some marshes in great abundance; but this quantity can be nothing in comparison with that which has been absorbed by plants during their lives, since this gas is known to be the great principle of vegetation: when the plant is destroyed, the vegetable earth which is produced owes its existence to the same elements which have produced the plant; for if it is supposed that these elements return to their original state at the destruction of the plant, from whence can vegetable earth be composed, which cannot exist without vegetation? Besides, hydrogen gas is actually produced in the analysis of all the before-mentioned substances, it also is extricated in coal mines, and there frequently causes dreadful accidents. But the principal restitution of hydrogen cannot take place but at the total destruction of the vegetable earth, when it by degrees parts with all its different component elements, and nothing remains but its silex; and this restitution is no doubt necessary to keep up that equilibrium among the elementary parts of our globe, without which it would advance too rapidly to its destruction; in this manner hydrogen being returned in part to the atmosphere, takes fire when certain circumstances permit; this combustion unites it to oxygen, and there thence results a new production of water. There is even reason to believe, as many very ingenious chemists have thought, that the rain of many storms is partly thus produced.

There still exists one difficulty *in accounting for the diminution of the waters of the ocean*, which is so great that it seems to bring the question back to its first state:—"At the time when "the waters of the sea were at their greatest height, when they "either covered the earth entirely, or for the greatest part, there "either existed no vegetation, or it only took place at the sum-"mits of the highest mountains; the plants were then too few to

" effect a diminution of the waters, which ought to have been " then greater, as the waters were then more abundant."

Before answering this question, I shall observe that the opinion which supposes the globe totally covered with water is only an hypothesis, which, however, is supported by so many strong probabilities, that I know no plausible reason which should make us reject them; but to perceive all the causes which could operate to produce a diminution of the waters at first, we must consider the then state of the globe, and all the circumstances in which it was placed.

When I said that vegetation was one of the chief causes of the diminution of the waters, I did not mean to say it was the only one. If water is necessary for the growth of plants, it is no less so for the lives of animals, and its decomposition in the latter way is no less certain. Its hydrogen is in animals the base of their fat, as it is of oils in vegetables; but this fat is not so abundantly found any where as in cetacious fishes, of whose substance it forms a very considerable part.

The prodigious multiplication of fishes is well known, which of course would be more numerous as the mass of waters was greater. Besides the fish properly so called, there also existed vast numbers of cockles, oysters, and other such animals; of shell worms, and moluscas; of polypi lodged in lithophites, corallines, and madrepores, which are employed in constructing calcareous rocks, that are uniformly composed of the pulverized remains of their shells, and their tubes joined together and united, which insensibly raising themselves from the depth of the sea, have reached the surface of the waters. At the time of their retreat these rocks formed isles, at first barren, but which were ere long covered with an abundant vegetation. This great work was thus effected at the expense of the waters, which diminished more rapidly, as organized beings became more numerous.

But nature does not always use means so progressive and regular; it sometimes produces grand phenomena, which execute in an instant, that which otherwise would have been the work of ages. It is thus that sometimes it causes volcanic fires to rush from the bottom of the ocean, which elevate the earth on high, open immense abysses, and of which the combustion, continuing during unknown ages, has destroyed a mass of water proportional to its activity; for it is a well-known fact, that water thrown on fire, in a certain proportion, augments its intensity, so that it is employed for that purpose on the small fires of forges.

Doubtless then those extinguished volcanoes, which are spread far and near over all parts of the earth, were once sub-marine; rising from beneath the waters, they were for many ages nourished at their expense; and this period is so remote, that were it not for the ancient monuments which nature has preserved for us, we could not even suspect their existence. It may be conceived that,

with such powerful means, with fire-vents so multiplied, the mass of water ought to experience a considerable diminution; and, on the other hand, its precipitation into the immense caverns formed by the volcanoes in the bosom of the earth, would depress its level very sensibly. These means, more multiplied formerly than they are now, ought to be regarded as the first agents employed by nature for bringing to light the inhabitable earth.

I have not yet mentioned minerals: they ought also to be considered as substances produced by water, and at its expense: it enters into them as a constituent principle, the proportions of which depend on the nature of each substance. Schistose, calcareous, and argillaceous substances afford it in the greatest abundance of all, these are in effect those secondary substances which are not formed, and do not appear but in proportion as the mass of waters diminish. This was also the opinion of Buffon, who considered the formation of these minerals as the second cause of the diminution of the waters. He attributes the first to the cavernose expansions formed by the primitive fire, which was not according to his opinion that of volcanoes; he then adds;

"But a second cause, perhaps more efficacious, though less apparent, and which I ought to state here as dependent on the formation of marine substances, is the actual consumption of an immense quantity of water which has entered, and which every day is entering into the composition of stoney bodies. The presence of this water can be demonstrated in all calcareous matters; it is found in them in such large quantities as to constitute frequently a fourth of their mass, and this water incessantly absorbed, by successive generations of shell-fish and other animals of this kind, is retained in their remains; so that in fact all our calcareous hills and mountains are composed actually of a fourth part of water; and the more shell-fish and other marine bodies of this kind multiply, the more must the quantity of water diminish, and the surface of the sea become lower."

I have now proved that there is a continual destruction of a large quantity of water by the operation of minerals, animals, and plants, and that if these substances restore a part of it at the moment of their decomposition, it is very inferior to what is actually consumed.

I do not pretend to exclude totally the other causes to which this fact has been attributed, such as the elevation or sinking down of mountains and the retreat of the water into subterraneous caverns; but these are momentary, accidental, and very inferior to those I have recited, which are constant and incessant; and thus that has been thought the effect of particular accidents only, which, it is evident is the consequence of the laws of organization, by which I have endeavoured to explain how nature operates in causing the diminution of the waters.

But it will be said in objection to what I have advanced,

that the operation of plants and animals, in diminishing the mass of water, is very small, since after so many ages this effect is little apparent, and that the extent of the sea is nearly the same, gaining on one side what it appears to have lost on the other.

To this I answer, that the history of man is but a day or two in comparison to the old age of nature: and that if the diminution of the sea is not apparent by its abasement, it may be by the decrease of its depth. In effect, if we pay attention to the sand, the gravel, the flints, the earth, and the stones, which streams, torrents, and rivers roll down from the land into the great basin of the sea, if we add to this the immense remains of marine bodies, of plants, shells, fishes, and madrepores, which have been accumulated for ages in the bottom of its abysses, we cannot but perceive, that its bed, vast as it is, must daily decrease; and that if the mass of waters did not continue to diminish, far from retaining its present bounds, it would elevate itself more and more, and finish by occupying anew those lands which it formerly abandoned.

Observations.—There is a little inaccuracy in M. Poiret's assertions relative to the operation of plants on water: he states that the *whole* of the water absorbed is decomposed, which is not the case; for all plants, as well as animals, return by perspiration or evaporation, the greatest part of the water they imbibe: still, however, the actual decomposition in this way is very great, and it is very probable that it even exceeds the proportion assumed by M. Poiret of 100 pints in a year to a large tree.

It is evident that the water decomposed by a tree must be equal to that which would produce all the hydrogen contained in its timber and roots, together with that in the whole of the remains of its leaves and branches parted with each year, and the vegetable earth produced by their decay: if then the whole of the inflammable parts of these substances, as is probable, owed their origin to hydrogen, since they would amount to more than eight hogsheads for a moderate sized tree forty years old, and since the quantity of water decomposed is, as M. Poiret states, seven times that of the hydrogen absorbed; and as the hydrogen in its solid combination probably occupies but a very small part of its bulk in the gaseous state, it may easily be conceived, how very moderate M. Poiret's computation is, of eight hogsheads of water only decomposed by a tree in forty years.

A late chemical discovery, made by Mr. R. Harrup, stated in Mr. Nicholson's Philosophical Journal (Vol. V. 8vo), adds another source for the diminution of water to those mentioned. This discovery, as yet not sufficiently noticed in proportion to its importance, consists of the actual power which azote possesses of absorbing oxygen from water, and of course decomposing the water, till the mixture of azote and oxygen arrives at that proportion, which constitutes atmospheric air.

Now as all animals which breathe decompose air by absorbing its oxygen, and thereby set free vast quantities of azote, and as this azote again decomposes water, the breathing of animals may be considered ultimately as occasioning a very abundant consumption of water.

On the means of impelling Ships without Wind.
Ann. des Arts, Vol. 20.

It is impossible to make use of the common kind of oars in a heavy sea, and for vessels with high sides; and it has been long wished to find some method of impelling vessels independent of the force of the wind.

We can demonstrate, and it is easy to conceive, that in endeavouring to find a point of resistance in water, a part of the force employed will be lost in repelling the water backwards; and that the greater the surface of the plane is, which acts on the water, the greater effect will be produced by a given force.

If instead of the common kind of oars, which impede the vessel in returning to their first position, and which do not act on the water more than a third of the time of each movement, another sort could be contrived which would act on the water incessantly, the points of resistance would be trebled; and if the surfaces of this other species of oars were made larger, the effect produced would be still more considerable.

It is doubtless true that a man has but a certain degree of force which he cannot augment, but he can employ this force in a manner more or less advantageous. It may be conceived, for example, that a man who operates by an alternating movement, as that of rowing, being obliged to diminish the velocity at the end of each turn, to make a movement useless to the object in view in raising up his body, to lose momentum by the total cessation of motion, which must take place before the oar can be impelled in a reversed direction, working in a sitting posture by the power of his arms alone, could not produce equal effect, for the same fatigue to himself, which another man could, who acting by an uninterrupted movement, as that of drawing or pushing, supports himself by the rope which he pulls, or by the bar of a capstan, and operates both by the weight of his body and the force of his muscles at the same time.

Most antient authors estimated the strength of a man at too high a rate, because they calculated from the effect produced for a few hours, by a degree of labour which the same men could not continue for several days in succession.

But experiments more lately made on the daily labour of

many men, working in the same manner, and for a long continuance, have demonstrated:

1st. That a man who rows eight or ten hours in a day, has only a force equivalent at most to a weight of fifty pounds raised one foot in a second.

2nd. That a man walking in a hollow wheel of a convenient size, has a force equal to a hundred pounds raised one foot in the same time.

3d. And that a man who draws at a cord or pushes at a capstan-bar has a force equal to seventy-five pounds raised one foot in a second.

It would be impossible to use the hollow wheel aboard a vessel for the labour of men (on account of the agitation of the waves); but the action of pushing at a capstan-bar, or pulling at a rope, may be applied in it to give motion to the apparatus we mean to propose, and this will occasion a great gain of power.

The force of a man in the action of rowing, which we have estimated at fifty pounds, is far from being entirely employed against the water; independent of the very considerable friction of the oar, the rower is obliged to bear a part of the weight of the oar for more than half the time, to raise it up at the end of each return, and to lose a part of his time and his force in bringing it back to its first position. All these losses of force cannot be estimated at less than one-fourth of the whole, or perhaps a third; there remains then a force of thirty-seven pounds and a half at most employed against the water, and of this we can prove by calculation, that at least nine-twentieths are employed uselessly, or without causing the vessel to advance, which reduces the efficient power of the rower to seventeen pounds at the most.

But with the apparatus of inclined planes, which we would substitute for the oars, the effect would be very different; entirely carried by the vessel, though always immersed in the water, with the exception of a little friction (which is much less than that of oars), the whole force of the men, equal to seventy-five pounds each, would be employed. In fact, though our inclined planes would have a surface much greater than that of oars, there would be some loss from the want of consistence of the point of resistance, and also from the obliquity of the planes. But we can demonstrate, that the whole of these losses of force will at most be only equal to a third of the total force, which will produce in the calculation an efficient power for each man equal to fifty pounds; while that of a common rower is not more than seventeen pounds; thus it may be seen that it is possible to invent an apparatus by which two men can produce as great effect in impelling a vessel, as five men at common oars.

Of the different projects hitherto made public for this purpose, none have yet succeeded perfectly; some, as those wherein mill-wheels were placed at the sides of the vessel, were too much in the way, presented too great a surface to the fire of the enemy, and acting on the water with but one paddle at a time, produced but little effect; others, such as a sort of oars always immersed in the water, which folded up into a smaller space when they were moved forward, lost most of their force in the action of folding up. Others, such as inclined planes placed behind the vessel, and moved by an alternating motion, failed partly for want of the necessary velocity, which ought to be calculated according to the angle of inclination of the planes, and the quickness with which the vessel should move; the same may be said of a species of screw, entirely immersed in the water, which also wanted the necessary velocity, and of which the spiral turns approaching too close impeded the action of each other.

To move vessels by elevating water, which was made to discharge itself behind their sterns, was also proposed; but this method was only practicable for small vessels, would take up too much room for large ships, and could be easily proved not to produce more effect than common oars.

Finally, Daniel Bernouilli, in a Memoir, which obtained a prize from the Academy of Sciences, in 1752, *on the manner of impelling vessels without wind*, proposed the use of inclined planes, immersed in the water, parallel to the sides of the vessel, which turning in a collar, so as to form an angle of sixty degrees with the keel, were moved in a plane perpendicular to the keel, by means of an horizontal handle.

The theory of this contrivance is, without doubt, very fine, but the means of putting it into execution present too many inconveniences.

The calculations also of Bernouilli require correction from the experiments lately made of the resistance of oblique surfaces; he has moreover estimated the force of a man too high, in valuing it at sixty pounds; and as he has proposed, that the men should act on his apparatus by an alternating movement, like those who saw timber, a much greater power could be gained by employing them in hauling or pushing at a capstan-bar, as has been mentioned.

Bernouilli, besides, after having calculated the velocity which his inclined planes should have to produce the best effect, concludes that they should act incessantly, and that there would be a loss of force in causing them to return at each end of their course; but, besides that, he estimates this loss too low; it is in vain that he would require of the men to give always an uniform velocity to the inclined planes, for all practical men know that no engine can resist the shocks which it

would experience from an alternating movement, if its velocity were not considerably reduced at the end, and at the commencement of each course.

But if a rotatory movement be given to the inclined planes, there need be no cessation of motion, or loss in reversing direction. If the inclined planes, always immersed in the water, are sufficiently separated not to impede one another; if a velocity is given to them, calculated according to their angle of inclination, the possible velocity of the vessel, and the experiments more lately made on the resistance of oblique surfaces; if the loss of force, caused by the resistance of the radii of the planes, can be proved to be diminished almost to a nullity by making those radii of iron; if the men, instead of an alternately reversed motion, work with a continued movement, and if the means of applying the apparatus, being much more easy of execution than those of Bernouilli, are such as may be used for large ships and in all circumstances; if that they may be put to work in less than a quarter of an hour, present no object for the fire of the enemy, and can be moved by men aboard the vessels, or by steam-engines, or on rivers by horses placed in the barges themselves; if all this can be done, it must be allowed that a near approximation to perfection is made.

The bases on which our calculations are founded are as follows:

We have supposed, with all naturalists, that in an indefinite fluid, such as the sea, the resistance of plane surfaces, and even of oblique surfaces, is as the squares of the velocity. We have taken it for granted, with all philosophers, that the resistance of a plane surface, moving in an indefinite fluid, may be valued as a column of the same fluid, of a base equal to the said surface, and of a height equal to the space which a heavy body must fall to acquire the same velocity; and as to the resistance of oblique surfaces, we have corrected the theory, from the experiments made by M. Bossuet and M. Condorcet, with boats headed with angular prows, forming different angles of inclination, from 12 to 160 degrees. We have also supposed, according to calculations and experiments made at Brest, by the celebrated Bourguer, that the resistance of a ship of 100 guns was equal to that of a plane surface of 150 square feet, and that of a galley to 16 square feet. We have deduced from these calculations, that a frigate may make a resistance equal to 50 square feet, and a gun-boat to 16 square feet.

The apparatus to which we alluded, shall now be described. We have already proposed inclined planes, moved circularly like the sails of a windmill; two apparatus of this nature should be placed at each side of the vessel, and two more behind; one

of which, such as should be placed at the side of the vessel, may be formed as follows, of a size proper for a ship of 100 guns.

The apparatus consists of three parts, the implement for acting on the water, the frame which sustains it in its place at the side of the vessel, and the machinery for putting it in motion.

The instrument for acting on the water, consists of an arbor fourteen feet long, and two inches in diameter, of iron; this carries eight wheels for acting on the water, to each of which it is perpendicular, and forms a common axis for them all; the wheels should be at equal distances from each other; each of them consists of eight arms of iron, each three feet long, so that the whole diameter of the wheel is six feet; each of these arms, at the distance of twenty inches from the centre, carries a sheet-iron plane (or paddle) sixteen inches square, which is inclined so as to form an angle of sixty degrees, both with the arbor and the keel of the vessel, to which the arbor is placed parallel.

To sustain this arbor and the wheels, two strong bars of iron, of between two and three inches thick, proceed from the side of the vessel at right angles to it, about two feet and a half below the surface of the water: these bars are two feet and a half long, and five feet distant from each other, and are forked at their extremities: directly over these, two other bars of the same thickness, and seven feet long, proceed from the vessel one foot and a half above the surface of the water, from whence they go obliquely into the water, so as to pass between the forks on the extremities of the first-mentioned bars, and to have their extremities four feet from the side of the vessel, and six feet beneath the surface of the water; which extremities have each a divided collar, in which the arbor described turns, being so placed in them, that four feet of it project beyond them at each end.

The bars which thus sustain the arbor, after passing through the side of the vessel, are continued for some distance inside, where a cross bar joins their two extremities, by pressing on which, the men can raise the arbor and wheels out of the water, so as to take them aboard or repair them.

To put the arbor and its wheels in motion, an axis proceeds obliquely from the vessel in same manner as the last described bars, from the middle space between them, and supported like them in the same way, by a forked bar beneath the water; the extremity of this axis carries a toothed wheel, which works in another toothed wheel two feet diameter attached to the middle of the arbor, and at right angles to it; the other extremity of the oblique axis which is within the vessel carries another toothed wheel, which works obliquely on an horizontal

wheel, which may be turned round within the vessel by one or more capstans, or in any other way.

It may be easily conceived, that the motion of this horizontal wheel will turn round the arbor, and the wheels holding the inclined planes, with more or less quickness according to the diameter which is given to it, although the arbor and impelling wheels are below the surface of the water; this axis, and its wheels, may easily be disengaged from the rest of the apparatus, by sliding it upwards through its socket in the side of the vessel.

The impelling wheels will be situated at about two feet from each other on the arbor, and each of the inclined planes at the arms, on account of their obliquity occupying only a space of eight inches of the circumference of each wheel, will leave an interval between it and the next of one foot; if this should not be space enough to prevent the action of one plane injuring that of another, the arbor may be made longer, which will admit of more wheels being placed on it than eight, of diminishing the number of arms on the wheels, and of leaving a greater interval between the wheels.

As each wheel has eight inclined planes, and there are eight wheels on each arbor, and two arbors at each side, there will be in all 256 planes (without reckoning those of the apparatus of a similar nature to be placed at the stern of the vessel); in order to give the vessel a velocity of five feet in a second, the inclined planes need only be moved with a velocity of twelve feet in a second; the resistance against each of them will be equal to ten pounds weight, and 500 men working the apparatus will produce the velocity mentioned.

For the force which is stated that each inclined plane will have to sustain, the iron arm that supports it need not be more than six lines thick, which will make but small resistance in passing through the water. The inclined planes should be made of sheet-iron, sustained by a frame of four small bars, and covered with copper of one line in thickness well soldered to it.

The apparatus of inclined planes at one side of the vessel is made to turn in a different direction from that at the other side.

Every large ship has two capstans, which are hardly ever used but when the anchors are to be drawn up; these capstans would serve to work the apparatus next them at both sides.

The two sets of impelling apparatus placed at the stern, are to be constructed like those described, except that each is to be supported by a single oblique bar, from the middle of which a second proceeds downwards perpendicularly to the arbor, and forms one of the supports for it, while the farther extremity of the oblique bar forms another.

The apparatus placed at the sides will be very convenient for turning the vessel about; and as they will be manageable with more facility than those at the stern, the latter need not be used but when the former are destroyed.

The capstans may be made to turn the horizontal wheels, which give motion to the machinery of the apparatus by an endless chain passing round a wheel on each capstan, and likewise round a wheel attached to the axis of each of the horizontal wheels: and each capstan is to have thirteen bars of seven feet long, and three men are to push at each bar: thirteen more men may be placed between the bars, each to draw by a strap attached to the extremity of the bar next them and passing round his breast; in this manner fifty-two men may be made to work at each capstan on each deck; and if the spindle of the capstan traverses through three decks, 156 men altogether may be made to work at each capstan, and 312 men at the two capstans; which number might, in most cases, be spared from working the guns in time of battle in a ship of the size mentioned.

Besides the men at the capstans, an additional number might be made to impel the vessel, by fixing two horizontal wheels, one at each extremity of the deck, round which an endless chain should pass, at which the men should haul by straps attached to it, in same manner as boats are drawn along rivers in many places; from these horizontal wheels, other endless chains should pass to the wheels of the described apparatus, to give them the required motion; at the endless chains 400 men might be made to haul on one deck in a vessel of the size mentioned, by making them move in double ranks.

In small vessels, where there would not be room for capstans, or wheels and chains, or in stormy weather, when they could not be worked, the men might be made to impel the machinery in a sitting posture, by an alternating motion like that of rowing; which might be effected by having an horizontal axis, carrying two cranks pointing in opposite directions, placed across the vessel, which axis should have a vertical toothed wheel attached to one of its extremities, so placed as to turn the wheel of the axis which passed through the side of the vessel to work the machinery outside; from the cranks two long bars, chains, or ropes, should pass along the decks, with sticks placed across them at regular intervals, by which the men pulling at the different cranks, so as alternately to give their force in opposite directions, would thereby cause the wheels to turn, and the apparatus to act.

The men may be either placed opposite to each other at different sides of the cranks, or all at one side; but in either case must be divided into two gangs, which are to act in succession, and in the lat er case, each gang must work at a different crank.

This method of impelling the vessel, though inferior to that by the capstans and endless chains, will however be preferable to the action of oars, inasmuch as in using it, the men will not have the weight of oars to carry, there will be less friction, and the inclined planes having much greater surface than the blades of oars, their effect will be nearly double that of oars.

The opposing surface of a vessel of 100 guns being, as before stated, equal to 150 square feet, estimating a cubic foot of water to be seventy pound weight, and the resistance of the water to be equal to a column of 150 square feet, and of the height which a body must fall to acquire the velocity of the vessel; the ship moving at the rate of five feet in a second will experience a resistance from the water equal to 4375 pounds, and the labour necessary to impel the vessel at this rate, (by the machinery) will be equal to 21875 pounds raised one foot in a second; 400 men, valued each at 75lb. elevated at the rate last mentioned, will produce a force equal to 28800 pounds, which after deducting all proper allowances for friction, the resistance of the arms of the water-wheels, and other impediments, will still have a very considerable surplus over the force required for impelling the ship.

The number of men requisite to move a frigate in the manner described, would be 280; to move a praam, 104; and from 40 to 60 for a gun-boat.

A ship of the line need never surrender till it is quite disabled: and as long as it can be manœuvred, it will for a great while resist a much superior force; and as in the proposed method of impelling the vessel, the men who work at the apparatus will be mostly beneath the surface of the water, but little exposed to shot, and may be often relieved, a ship may thus keep the sea though greatly injured, wait for the night, and escape from the enemy.

Besides what is already given of this paper, the authors enter at large into the farther advantages this method of moving ships would give their countrymen in attacking our ships, and particularly in escaping from them, and in getting out of blockaded ports, and are very diffuse on the great facility it would afford of invading this country, in calm weather, in fogs, or when the wind prevented our ships from getting out of port. They also mention the advantage there would be in using steam-engines to give motion to their apparatus; and state that Mr. Fulton did not succeed in his attempt to move vessels by steam-engines, chiefly because the paddles of the wheels which acted on the water in his method, acting but one at a time, opposed too little surface to it, and were in other respects applied in a disadvantageous manner. They also propose this method for moving boats on great rivers, and to have a machinery turned

by horses aboard them, though they acknowledge it would not be so proper on canals as the method in use; they have detailed the machinery proper for this latter purpose, which may easily be imagined from what has been described; and also have inserted very long and minute algebraical calculations to prove the several facts stated, which we believe to be correct, but could not insert without extending the extract beyond the proper bounds.

Observations.—The chief objections which the Author of this paper makes to Bernouilli's method for the same purpose, may be applied to his: namely—that it would present too many inconveniencies for execution, and be too cumbrous; though it appears simple to them, its great multiplicity of parts, of paddles, of wheels, and iron frame-work, would make it seem very complicated to sailors, and the room it would take in stowage aboard ship, when not used, would be more than could be spared; the iron frames for attaching it to the sides of the ship, are neither strong enough, nor sufficiently well braced; but, notwithstanding its defects, it is certainly the best which has yet been made public. The principles on which the theory of the author is founded, are demonstrably right; and if the application of them proposed does not suit the use intended, it may lead to others which will do so.

It is certainly possible to construct another apparatus on the same principles, which would not occupy a twentieth part of the room aboard when not in use, might be shipped and unshipped in a few minutes, and which would require no frame-work to be placed for it outside the ship, and most of whose parts would answer for other purposes aboard, in case of necessity; an apparatus possessing these properties is known to the writer, but cannot be detailed without anticipating the subject of a paper intended for publication, which probably hereafter may appear in this work.

The disadvantages which the operation of rowing labours under, should give a preference to another method of impelling vessels generally known, but only occasionally practised by our sailors,—namely, that of skulling; in this operation the man who moves the oar has not to sustain its weight as in rowing; he has no loss of motion in bringing it from one position to another, as it acts equally in both directions; and it is only inferior to an inclined plane moving circularly, by losing its momentum at each change of direction. There would be no difficulty in contriving means by which many men might work a single oar in this manner; a pulley at each side of the vessel, with a rope passing through it from the handle of the oar along the deck, by which a gang of men at each side might haul alternately, would be sufficient for this purpose. Skulling would afford

another advantage over the use of oars for the larger kind of vessels now moved by them, such as galleys and gun-boats, for in them the number of oars necessary are a considerable burden to the vessel, so much so in a galley as to make a perceptible difference in its draught of water, every time they are raised out of water to give a new impulse; but three or four large oars for skulling, which are all that would be necessary, would not take up any room or occasion any burden that signified.

The moving vessels of the size mentioned in this manner is no untried project; very large junks are impelled in China in this way; and all who have been there agree that this is the common way of moving vessels in that country, when sails cannot be used, or they cannot be drawn along by ropes from the banks of their canals or rivers.

There is no doubt but if this method were more in use, means would be found of facilitating the action of the oar: a very simple one used by the Chinese for this purpose gives considerable assistance; they attach the handle of the oar to the deck by a moveable bamboo, which permits all the force required to be used in impelling the oar back and forwards, without needing any to keep it in its due position.

Small boats are too unsteady, and the position of the weight of the man who skulls is too unfavourable to their proper balance, to give this method all its power in them: but the double boats constructed for Sir Sydney Smith, are so very steady, so light, make so great resistance to lateral motion, and have so much space in the stern for the oars, that they are altogether the best calculated for this operation of skulling, in addition to their other good qualities. This way of moving them would also have peculiar advantages in time of battle, as the oars in the stern would be much less in the way than those at the sides required for rowing.

AGRICULTURE.

On the Form of Animals. By Henry Cline, *Esq. Surgeon. Com. Board of Agriculture*, 1805.

It is the intention of this communication to ascertain in what instances crossing the breed of cattle is proper, and in what prejudicial: and the principles upon which the propriety of it depends.

It has been generally understood that the breed of animals is improved by crossing with the largest males. This opinion has done much mischief, and would have done more if it had not been counteracted by the desire of selecting animals of

the best forms and proportions, which are rarely to be met with in those of the largest size. Experience has proved that crossing has only succeeded in an eminent degree in those instances in which the females were larger than in the usual proportion of the females to the males; and that it has generally failed when the males were disproportionally large.

The external form of domestic animals has been much studied, and the proportions are well ascertained. But the external form is an indication only of internal structure. The principles of improving it must therefore be founded on a knowledge of the structure and use of the internal parts.

Of these the lungs are of the first importance. It is on their size and soundness that the strength and health of an animal principally depend. The power of converting food into nourishment is in proportion to their size. *An animal with large lungs is capable of converting a given quantity of food into more nourishment than one with smaller lungs; and therefore has a greater aptitude to fatten.*

Chest.

The size and form of the chest indicate the size of the lungs, of which the form should approach to the figure of a cone having the apex situated between the shoulders and its base towards the loins: a circular form of chest is preferable to one deep and narrow, for though the latter may have greater girth, the former will have greater internal space in proportion.

The Pelvis.

The pelvis is the cavity formed by the junction of the hip bones with the rump bone; this cavity should be large in a female, that she may be enabled to bring forth her young with less difficulty; when this cavity is small, the life of the mother and her offspring is endangered.

The size of the pelvis is indicated by the width of the hips and the space between the thighs; the breadth of the loins is always in proportion to that of the chest and pelvis.

Head.

The head should be small, by which the birth is facilitated to the offspring, it also indicates the animal to be of a good breed, and occasions less weight of unprofitable substance to the consumer.

Horns are useless to domestic animals, and occasion a great weight of bone in the head; the skull of a ram with horns weighed five times as much as that of one without horns, each being four years old. A mode of breeding which would prevent the production of horns, would therefore afford a considerable saving.

The length of the neck should be proportioned to the height of the animal, that it may collect its food with ease.

Muscles.

The muscles and tendons, which are their appendages, should be large, by which an animal is enabled to travel with greater facility.

Bones.

The strength of an animal does not depend on the size of the bones, but on that of the muscles; many animals with large bones are weak, their muscles being small.

Animals imperfectly nourished during growth have their bones disproportionally large: If this originated from a constitutional defect, they remain weak during life; large bones may therefore indicate an imperfection in the organs of nutrition.

Of the improvement of Form.

The chief point to be attended to for the improvement of form, from Mr. Cline's principles, is the selection of males for breed of a proportionally smaller size than the females, both being of approved forms; the size of the fœtus depends on the size of the male, and therefore when the female is disproportionately small, her offspring has all the disproportion of a starveling, from want of due nourishment.

The larger female has also a greater supply of milk, and her offspring is therefore more abundantly provided with nourishment after birth.

When the female is large in proportion to the male, the lungs of the offspring will also be greater; by crossing in this manner there are produced animals with remarkably large chests, as has been often noticed: the advantage of large lungs has been already pointed out.

In animals where activity is required, this practice should not be extended so far as in those which are intended for the food of man.

The size of animals is commonly adapted to the soil which they inhabit; when the produce is scanty, the breed is small; the large sheep of Lincolnshire would starve, where the small sheep of Wales find abundant food.

Crossing may be attended with bad effects, even when begun on good principles, if the above rule be not attended to throughout; for instance, if large ewes were brought to Wales, and sent to the rams of the country, the offspring would be of improved form; and if sufficiently fed, of larger size than the native animals, but the males of this breed would be disproportionately large to the native ewes, and therefore would produce a starveling ill-formed race with them.

The general mistake in crossing has arisen from an attempt to increase the size of a native race of animals; being a fruitless effort to counteract the laws of Nature; which, from theory, from practice, and extensive observation, Mr. Cline concludes

to be decidedly wrong; for in proportion to this unnatural increase of size, they become worse in form, less hardy, and more liable to disease.

Observations.—In this very excellent communication of Mr. Cline's, which is fraught with valuable information, there is one position which can be only understood in a general sense, namely, that females of the largest size give most milk in proportion: small cows are often known to give more milk than large; the quantity of milk seems to depend on the particular breed, and on the supply of food.

Fatness also does not seem to be inconsistent with every disease of the lungs, though no doubt it is with most, at least if we may argue from the human race to brute animals, as nothing is more common than for fat people to be asthmatic.

The directions for breeding given by Mr. Cline, are certainly the best calculated to produce fine healthy animals, and of course the most wholesome meat; but there is some doubt whether this would be so agreeable to the breeders, as the exuberant fatness, which has been so fashionable among them for some years past, and which in all probability is inconsistent with the health of the animal: a prodigious fatness is justly considered as a state of disease in mankind, and there is no reason why it should not be so in beasts also: as a confirmation of the opinion that the excess of fat does not improve the quality of the meat, it is pretty generally acknowledged that the average of mutton in the London markets affords a much more coarse and unpalatable food than what was in general to be had some years back, before the prodigiously fat breeds became so prevalent. There is great reason to believe that the fine flavour of the meat may not solely proceed from an adequate age of the animal, but may also depend on particularity of breed, as much as great fatness or quality of wool; and if the breeders of sheep would attend a little to this circumstance in future, they would confer a singular favour on all those who eat mutton, who are at least as numerous as the tallow-chandlers and clothiers, whose interest, next to their own, they have hitherto chiefly studied in this matter.

Account of Mr. DAVY'S *Paper on the Analysis of Soils, communicated to the* BOARD *of* AGRICULTURE. 1805.

MR. Davy having first mentioned that the advantages of analysis of soils have already been felt by some eminent cultivators since they were pointed out by Lord Dundonald and Mr. Kirwan, and that Mr. Young has furnished may useful facts and observations with regard to them, proceeds to state the various substances which usually compose the soils of this country; namely, silex, alumine, lime, magnesia, matter from animal

decomposition, matter from vegetable decomposition, salts, and oxyds.

The instruments and chemical re-agents proper for making analysis of soil, may be had, ready packed in cases, at Mr. Knight's, Foster-lane, Cheapside.

Mr. Davy recommends that when the soil of any estate is examined, a variety of specimens should be taken from different parts, whenever there is the least reason to suppose that any difference of soil exists, for sometimes one part of the field is silicious, and another calcareous. Each specimen should consist of between 200 and 400 grains, should be taken up from two or three inches beneath the surface, at a dry season, and be exposed to the atmosphere till dry to the touch, and preserved in bottles with ground stoppers till the analysis is made.

The specific gravity of each specimen should be examined first: this may be done by filling a small bottle with water, weighing it, pouring out one half, and putting in the soil in its place till the bottle is again full, then weighing it a second time and noting the difference: thus if the bottle of water weighs 400 grains, and when the soil is added, as described, weighs 600 grains, the specific gravity of the soil will be 2; that is, it will be twice as heavy as water; and if the mixture weighed 565 grains, the specific gravity would be 1825, water being 1000.

1. To ascertain the absorbency of the soil, it should be heated in a vessel at 300 degrees Fahrenheit, or till wood held in contact with the vessel begins to be charred: if after 12 minutes the loss of weight should be 50 out and 400 grains, the soil may be considered as highly absorbent.

2. The next process should be to separate with a sieve, the stones, gravel, roots, and vegetable fibres, none of which should be removed before the former operation, as they are often themselves highly absorbent.

The weight of these matters should be noted, and the quality of the stones or gravel examined; if they are calcareous, they will effervesce with acids; if silicious, they will scratch glass; if of the common aluminous class of stones, they will be soft, easily scratched with a knife, and will not effervesce with acids.

3. The sand should next be separated by agitation in water; it will first subside, and the other matters will remain for two or three minutes suspended in the water, which should then be poured off, filtered, dried, and weighed, the sand should be weighed also, and the lixivial water examined as to its containing salts, and animal or vegetable soluble matters, in solution.

4. The sand may be examined by gradually pouring muriatic acid on it, (if any effervescence ensues at first,) till the acid ceases to be neutralized, or loses its sour taste; this process will dissolve all the calcareous part of the sand, and the re-

mainder will be silicious, which should be washed, dried, and heated strongly in a crucible; the difference between its weight and that of the whole sand, indicates the proportion of calareous sand.

5. The finely divided matter, separated in the third process, consists sometimes of all the four primitive earths, with animal and vegetable matter; to ascertain the nature of this matter, muriatic acid in equal weight, with twice its weight of water added, should be poured on it, often stirred, and suffered to remain at rest for an hour and half: this will dissolve the carbonate of lime, magnesia, and oxyd of iron, contained; the fluid should be separated by a filter, and the solid matter washed, dried, and weighed, its loss will denote the quantity of solid matter dissolved; a little prussiate of pot-ash added to the solution will shew by a blue precipitate the presence of oxyd of iron if any exists. To the remaining fluid, carbonate of pot-ash should be added till all effervescence ceases, and the taste indicates an excess of alkali. The precipitate thrown down by this process will be carbonate of lime.

The remaining fluid being boiled after this, will deposit the magnesia contained, combined with carbonic acid.

6. After the fine matter of the soil has been acted on by muriatic acid, the quantity of insoluble animal and vegetable matter may be ascertained, by heating it to strong ignition in a crucible till no blackness remains in the mass, which should be often stirred with a metallic wire during the process; a smell from the roasted matter resembling that of burned feathers, indicates animal matter; and a copious blue flame arising denotes a considerable proportion of vegetable matter. When speed is required, the process may be hastened by adding nitrate of ammonia by degrees in the proportion of one fifth of the residual soil.

7. The next process is to ascertain the alumine, silex, and oxyd of iron contained; for this purpose, the matter after undergoing the former operations should be boiled for two or three hours in sulphuric acid, diluted with four times its weight of water, the acid should be 1½th the weight of the soil.

The insoluble substance remaining may be considered as silicious, and its quantity may be known by drying and weighing it.

If the fluid contains alumine and oxyd of iron in solution, carbonate of ammonia added in excess throws down the alumine, and leaves the oxyd of iron, which may also be separated by boiling.

8. Saline and soluble animal or vegetable matter, is known by examining the water of lixiviation used for separating the sand, this should be evaporated to dryness at a heat below that of boiling water. If the solid matter obtained be of a brown colour, it may be considered vegetable extract: if its smell be

strong and fœtid, it contains animal matter; if it be white and transparent, it is principally saline matter; if this saline matter scintillate on burning coals, it shews it to be nitrate of lime, potash, or ammonia; sulphate of magnesia is detected by its bitter taste, and sulphate of potash by its producing no alteration in solution of carbonate of ammonia, and precipitating muriate of barytes.

9. When sulphate of lime is supposed to be contained in the soil, a given weight of it (as 400 grs.) must be heated red for half an hour in a crucible, mixed with a third of powdered charcoal, the mixture must be boiled for a quarter of an hour in half a pint of water, then filtered, and the fluid exposed for some days to the air in an open vessel. If any soluble quantity of sulphate of lime existed in the soil, a white precipitate will gradually form in the fluid, the weight of which will indicate the proportion.

After this the remaining soil may be examined for phosphate of lime by digesting muriatic acid on it, evaporating the solution, and washing the solid matter, which will leave the phosphate of lime.

Chemical Composition of fertile Soils.

FERTILE soils always consist of certain proportions of aluminous and calcareous earths in a finely divided state, and of vegetable or animal matter.

The quantity of calcareous earth is very various, and in some cases very small; a very fertile corn soil from East Lothian afforded eleven parts in a hundred of calcareous earth, and twenty-five of silicious sand; it however afforded some indications of a small quantity of phosphate of lime, by which its fertility might be in some degree caused, as this substance is found in wheat, oats, and barley; it also contained nine parts of animal and vegetable matter. An equally productive soil from Somersetshire, on the contrary, contained eight ninths of calcareous earth to one ninth of silicious sand, held about five parts in the hundred of vegetable and animal matter, and had no phosphate of lime.

In general, bulbous roots require a more sandy soil than grasses, and less attractive of moisture; plants and trees whose roots are hard and fibrous, will thrive best in a soil moderately dry, which does not contain too much vegetable matter.

Improvement of Soil.

A SOIL deficient in fertility should be compared with a fertile soil in its neighbourhood in a similar situation, the analysis of both will shew what is wanting in the inferior soil. Thus if the fertile soil contain a larger proportion of sand, calcareous earth, or clay, &c. the process of amelioration for the other soil would consist in adding to it the same substance; in adding lime, magnesian lime-stone should be avoided, having been found to be

injurious to land in several instances. (vid. Phil. Trans. for 1799.) Magnesian lime-stone is known by its greater hardness, by the greater length of time it requires for solution in acids. and by analysis.

Improvements made on soils by rendering them of the best composition as to their earthy parts, establishes a permanent fertility, and renders them capable of attracting a large portion of vegetable nourishment from the atmosphere, and thereby of yielding crops with comparatively less labour; whereas by supplying animal or vegetable manure the benefit is only temporary, and in all cases exhausted by a certain number of crops.

Observations.—Those who are moderately acquainted with chemical matters will certainly find the directions given by Mr. Davy, for analysis of soils, extremely valuable. (These are contained more fully in the Repertory of Arts, Nos. 38 and 39.) But those who have never performed any chemical operations, would do well, before they attempt to examine soils in this manner, to get some previous instructions in general chemistry, and learn particularly the effect of the chemical re-agents; for which latter purpose they will find the small volume published by Professor Gottling on chemical tests, particularly serviceable. Farmers, in general, however, would find it more advantageous to employ some chemical gentleman to make the analysis for them of their soils, than to spend their time in learning a new science, whose operations require the utmost delicacy and address in most cases, and in none more than in analysis. If no chemist lived near them, specimens of the soils, collected as here directed, packed in bottles with ground stoppers, and properly numbered, might be forwarded for examination at a moderate expence to a considerable distance. It would be an object worthy the attention of the Board of Agriculture to facilitate the investigation of soils in this manner, by making it worth the while of some experienced chemist to analyse soils for farmers on moderate terms, and publicly advertise to receive specimens from all parts of the kingdom for this purpose.

Account of Communications on bettering the Condition of Labourers and their Families, by letting them small portions of Land;—published by the Board of Agriculture, 1805.

COMMUNICATIONS to the Board of Agriculture by Sir William Pulteney, Sir John Sinclair, Thomas Estcourt, Esq. Sir Henry Vavasour, and Thomas Babington, Esq. all agree in pointing

out the most beneficial effects to arise from letting small portions of land to the labouring classes, not only in the great comfort and relief which it affords them individually, but to the community at large, by diminishing in the most effectual manner the great burden of poor rates.

Sir W. Pulteney relates the account of an acre and sixteenth managed by Jane Millwood, the wife of a collier, in a manner that might do credit to the most experienced farmers, and affording alternate crops of potatoes and wheat (the wheat being always sowed as the potatoes were taken up,) for 13 years, with a greater produce than those of the neighbouring farmers. This woman cultivated the ground chiefly with her own labour, being only occasionally assisted by her husband; and was enabled by its produce to rear a family of six children, without any parochial assistance. She keeps a pig chiefly on the produce of a small garden, (part of the same ground,) and the manure from this animal, with the dirt of the house and the scrapings of the road, is her only supply for her little farm.

Sir T. Estcourt mentions a system for the above design applied to thirty poor families, with the most beneficial effects, which consisted of the following regulations:

1. That each person should have a portion of arable land proportioned to the number of his family, such as could be cultivated by his family, without improperly interfering with his usual labour, but in no case to exceed an acre and a half, at the rent of 1*l*. 12*s*. per acre.

2. That a fourth of the land in each person's occupation should annually be well manured in rotation and planted with potatoes: the rest to be managed as they thought fit, except that they should never have two exhausting crops, namely, of wheat, rye, oats, or barley, in succession.

3. That the land should be forfeited to the landlord, if not cultivated and manured as specified; if the tenant should be convicted of felony, or any offence for which he should be liable to fine or imprisonment; or if he should receive any parochial assistance, except for medical advice, or in consequence of laws relating to the militia, or defence of the country.

4. That the land should be granted for a term of fourteen years, but that the lease should be void on either party giving three years' notice.

Of thirty-two families in the parish (consisting of 140 persons) of the former description, only two declined receiving land, and those, with four infirm old people, have alone required any assistance from the poor-rates, since Michaelmas, 1801. The two families afterwards took land rather than go to the work-house, and have received no parochial relief since 1803.

Mr. Estcourt agreed to "joist" cows for the cottagers at 5*l*. 4*s*.

per annum, as a cow is deemed a great assistance to a poor family. The poor-rate from October, 1801, to April, 1802, was 242*l.* 16*s.* but was reduced by the above plan from October, 1803, to April, 1804, to 12*l.* 6*s.* Mr. Estcourt justly observes that "if charity alone was the object, *The best species of "charity is that which enables the poor man to exert with effect, "and with honest freedom, his strength and faculties for the "support of his family.*" He concludes his communication with a set of regulations advisable for adoption where similar plans are carried into effect.

Sir J. Sinclair has laid down a plan of cultivation, by which a poor man may be able to keep a cow on three and a half acres of land, (worth from 30*s.* to 40*s.* per ann. each,) and produce food for his family.

Mr. Babington has adopted a larger scale in his allotments of land to his cottagers; his principal object was to enable them to keep cows, and for this purpose they had from three to fourteen acres each. The farmers in the neighbourhood were very averse to the system of letting land to the cottagers, but Mr. Babington found their prophecies of backward rents,—ruined tenants,—spoiled labourers and mechanics,—and endless trouble to the landlord, entirely fail. The only evil, he says, that he could perceive, was that "the cottagers were inclined to spend too much time in looking at their ground and stock on Sundays."

Observations.—Many advantages would arise to the community from letting small portions of land to cottagers; among those already stated, the extreme reduction of the heavy tax of poor-rates, and in some cases its almost total annihilation, is no doubt the chief, but others are not to be disregarded; in many instances those who before were a burden to the nation, would be able to pay some small taxes, and thus become actively serviceable; if the plan should become general, the great mass of the people being by it relieved from the necessity of depending on the markets for the prime necessaries of life, would greatly diminish the danger of artificial scarcity.

A vast proportion of labour would also be added productively to that of the country, which is now lost: the wives and children of cottagers, who do little or nothing at present, would have full employment by this system, and the hours which are now frequently lost at the alehouse by the males of the family, would be spent in a manner equally profitable to themselves and the country. There is besides a principle in the human constitution, that is not so much taken into account as it ought; when a man has his mind elevated by strong desire, a sort of enthusiasm takes place, which actually makes him capable of much greater bodily exertion, without injury to himself: when

men work on their own account with a strong probability of every additional exertion producing a sensible remuneration, this sort of enthusiasm seldom fails to ensue; on the contrary, when hope does not exist, and spirit is extinguished, the man not only does not perform near so much, but becomes incapable of doing so. If any doubts this position, let him compare the products of the labour of a pauper in even the best conducted poor house, with that of the several cottagers whose exertions have been published, and his doubts will vanish.

It is in general understood that a very political sovereign, to whom the nation is indebted for many wise regulations, had an act passed to oblige landlords to allot small portions of land to cottagers. It would certainly be an object of importance, worth the attention of those gentlemen who have taken pains to bring this matter before the public, to investigate the causes of this act having fallen into obscurity, and to concert measures for either reviving it, or having a new one passed of a similar nature.

As to the quantity of land to be allotted to a cottager, it appears to be a good general rule that the tilled part should not exceed what might be managed by his family with the spade and hoe, without any assistance from the plough; though, if on such a small beginning by good management a cottager can acquire means to extend his holding profitably, the reasons for preventing him are by no means so conclusive as are generally imagined; to enter fully on the discussion of this subject, would involve the question of the comparative advantages of large farms and small farms, which would require at least a paper to itself: therefore, we shall only at present remark that all the advocates for the exclusive use of large farms, have servilely copied one another in that false mode of reasoning, called by logicians the *petitio principii*, in which they have taken it universally for granted, that the occupier of a small farm does not possess sufficient capital for its proper management, than which nothing can be more contrary to the common rule of chances; for, as there is a much greater number of men who have small capitals, than who have large, of course there is a greater chance that for the small farm there may be found a man of adequate capital.

Burning Stubble. By Mr. W. Curtis.—*Com. Bd. Agr.* 1805.

Mr. W. Curtis, of Lynn, Norfolk, found very beneficial effects from burning the stubble of oats, which was left eighteen inches high for this purpose, on a field broken up from old pasture

the same year; he afterwards sowed wheat and oats in succession on the same ground, the stubble of both which was burned in in the same manner. The ashes were in every case ploughed in to a small depth, and the verges of the field mowed previous to the burning, to prevent accidents. After the third crop of corn, all of which were abundant and remarkably free from weeds, the field was laid down with clover and grass seeds, and the ensuing crops of both hay and grass proved infinitely finer than those before the ground was broken up.

Another piece of land was cropped for three successive years, in the same manner as the first, to which it was similar in every respect of soil, aspect, and previous management, but in which the stubble was ploughed in, instead of being burned; the produce of each crop on it was much inferior to that of the first experiment, and the weeds increased so greatly, that on laying the land down to grass, they overpowered the grass-seeds so much that it was necessary to re-sow it; and ever after, while Mr. Curtis held it, the grass and hay produced were coarse and full of weeds, and consequently inferior both in value and quantity to those of the other field, on which the stubble had been burned.

Observation.—This is an additional proof to those given in the former Number of this Work, of the ameliorating quality of carbonaceous matter to land, and the great benefit of burning, both in producing this matter, and extirpating weeds in the most effectual manner.

Account of Communications to the BOARD *of* AGRICULTURE, *on Paring and Burning. Published* 1805.

THE result of twenty-seven communications to the Board of Agriculture on paring and burning, have been all greatly favourable to this practice. Almost all kinds of soils have been tried in this manner, in various counties in England and Wales. It may be useful to enumerate the different soils mentioned in the reports, some of which soils are of that nature on which the practice has been esteemed most doubtful, and yet on all it was followed by uniform and decided advantage. The soils mentioned are clay, clay and chalk, poor cold clay, clay sand and loam, clay-moors and heaths, strong wet land, sand, *thin skinned warren, poor gravelly heath*, heath, stone brush and light loam, loams, loam gravel and rich land, loam on limestone, chalk, chalk heaths, downs, fens, peat, rushy pastures, old pasture, and rough uncultivated ground. The experiment

made on this matter by Mr. Wright, of Pickworth, is one of the most remarkable: he broke up sixteen acres of gravelly heath, and though he managed it in the best manner possible, by tillage alone, lost four crops in succession, through the ravages of grubs, wire-worms, and other insects, always abunddant in uncultivated dry ground; he afterwards broke up twenty-four acres of the same gravelly heath, which he pared and burned, which produced a most plentiful crop of turnips, and another equally good of barley, and remained in the most favourable state for laying down to grass with oats. An experiment on a small scale, made by the Rev. G. Swayne, near Bristol, also deserves notice: a lump of ferruginous yellow clay was put into a coal fire till it was red hot; when cold, the outside was red for half an inch in depth, and the inside black; it was then bruised down to the consistence of coarse sand, put in a drinking-glass, and moistened with rain water: some of the unburned earth was placed in a glass, and managed afterwards in the same manner; in both were sown a few grains of wheat and mustard seeds. The seeds in the burned earth vegetated speedily and vigorously, while not a single seed sprouted in the unburned earth.

Most of the reports agree in the benefit derived from the actual heat of the fires to the ground, as well as from the ashes, the spots where the fire lay were uniformly the most fertile, though the ashes were carefully scraped off them; for this reason several recommend to make the heaps small, that they may be the more numerous. The ashes of small heaps were also found to be the most ameliorating; the reporters observe that they were always black, while those of the large heaps, where the fire was powerful, were red; which farther confirms what has been mentioned in the former Number of this Work, of the advantage of burning so as to produce the most carbonaceous matter.

On sowing Turnips among Wheat, and preparing the Seed so as to escape the Fly.—Com. Bd. Agr. 1805.

Mr. W. Dark, of Devon, tried an experiment on sowing turnips among wheat, which succeeded exceedingly well; he sent a man, in moist weather, up and down the furrows among the wheat, at the time it was getting into ear, who sowed about a quart of turnip-seed per acre; and, although in reaping the wheat, the tops of many of the turnips were cut off, yet they grew so fast afterwards, that they were valued at 5*l.* per acre. Several of Mr. Dark's neighbours imitated this example; but he thinks it will not succeed but where the wheat

has been sown in old meadow or pasture, not naturally rich, and after paring and burning, as the least grass or weeds defeats the purpose.

The Rev. Mr. Parsons, of Monmouth, had some turnip-seed prepared as follows, and sown in two different fields, half a mile apart, varying in quality and unequally manured, both of which succeeded alike in escaping the fly and producing an ample crop; while eighty acres adjoining, managed with the utmost attention, but sowed with unprepared turnip-seed, totally failed, though resown thrice in succession. The seed was thus prepared by Mr. Parsons: a mixture of sulphur, nitre, and common salt, was thrown on one half the seed, enough to absorb the water with which it was previously moistened; this prepared seed was then mixed with the other half; at the close of each day one pint of it to a statute acre was sown before the first harrowing, and another before the last harrowing.

Observations.—The effect of keeping off the fly, occasioned by Mr. Parsons's composition, most probably was due to the sulphur. It has been noticed by M. Sage in the foregoing paper on Hornblend, who had an extensive cabinet of minerals under his care, that the flies never came near the places where they were kept, which confirms this opinion. The effect of the salt was probably to produce a more quick vegetation, by attracting moisture from the air to the growing seed.

Sulphur is so cheap, that surely no objection can be made to trying this matter extensively in future; the most expensive article in the composition,—the nitre,—may probably be omitted without diminishing the effect of the composition.

On feeding Cattle with Potatoes, prepared by Steaming and Baking.—Com. Bd. Agr. 1805.

Charles Curwen, Esq. used steamed potatoes for his cattle, on a very extensive scale; in one year 60,000 stone were consumed by them. The washing was usually very troublesome; to facilitate this operation, Mr. Curwen used a machine in all respects like that described in our former Number, for washing manganese, directed by Dr. Dyce, of Aberdeen. His apparatus for steaming consisted of four moveable vessels, to hold potatoes, perforated at the bottom; these were all made to fit on lead pots, which communicated by pipes with the top of the steam boiler, and had each cocks to let off the condensed water. The lead pots were placed so that a crane in the centre of the house could lift the wooden vessels off them, and convey them round to a large back, which held the washed potatoes, to

be filled; and also to stone troughs in which the potatoes were bruised for use after being boiled; another crane was placed so as to convey the potatoes from the washing apparatus to the back.

Mr. Curwen gave to each horse per day, 1½ stone of potatoes, 8lb. of oats, 7lb. of hay, and 4lb. of cut straw, at first; he afterwards gave straw entirely, in place of hay, with equal advantage to the horses. He kept nearly 100 horses in this manner, and estimates the annual saving from this method of feeding, above the former method, to be 1000*l.*

Mr. Pierrepont, in another communication, greatly recommends the use of baked potatoes for feeding cattle; he mentions that potatoes prepared in this way are less apt to turn sour, or scour the cattle, are more dry, (so that the animal fed with them drinks more,) and are harder when cold, so as to be flung to the stock with greater convenience, than when steamed. In 1802, he fattened fifteen brace of bucks chiefly with them, which were sold to Mr. Biggs, Temple-bar; and also two oxen, three cows, and two pigs; the bucks had 6lb. per day each: they produced remarkably fine and well-flavoured venison.

His method of baking was to place the potatoes in iron digesters of six gallons each, which were put into an oven heated from beneath with flues, which passed round the top of this oven into a chimney.

Observations.—The apparatus for baking does not appear to have any remarkable advantage, or should be described more particularly; wire baskets would be cheaper and better for the purpose than the digesters; and an oven prepared according to the directions given by Count Rumford, would no doubt be superior in efficacy to that of Mr. Pierrepont.

A gentleman, known to the Proprietor of this Work, had an oven of sheet-iron enclosed in brick-work, and fitted up according to Count Rumford's plan, which he used for the same purpose as Mr. Pierrepont, but whose method of placing the potatoes in the oven was much better; this gentleman had a number of shallow pans (constructed to hold the potatoes) of nearly the same length and breadth of the inside of the oven; these were contrived so as to be arranged one over another, like drawers, within the oven, but with some interval between each other, and so as not to touch the sides of the oven, to admit free circulation of the heated air, and prevent burning the potatoes. This method was found to answer extremely well in preparing potatoes for cattle; pans formed for the most part of wire lattice would probably be preferable to the above, or at least the sheet-iron pans should be perforated with numerous holes, to prevent burning, and equalise the heat.

RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL, CHEMICAL AND AGRICULTURAL DISCOVERIES.

No. III.] *September, October, November, December.* [1805.

AGRICULTURE.

On the Breaking up of Lands, and after certain Courses of Crops, laying the same down to Pasture.—Com. Bd. Agr. 1805.

MUCH useful information will be found in the accounts, which sixteen different agriculturists (including Mr. Taylor's, placed under the head of *Draining)* have given of their practice, or of what they propose, in the management of newly broke up lands, intended to be laid down again to pasture. The soils treated of, consist of a cold soil or stiff blue clay, a wet loam or yellow brick-earth under which lies a strong clay, strong red clay, strong clay with spots of flinty gravel, clay, high wold land, woodland, wood-cock soil or dark-grey wet loam, loam, low bottoms, light loam, sandy loam, dry loam inclining to sand, wet sand, heath land, sandy heath, sand, salt marsh, fen land, and peat. Many useful observations will be found interspersed in these papers, relating to draining and other subjects not indicated by the titles thereof. Mr. *W. Ames*, in particular, has given some useful hints on the best mode of ploughing the furrows of clayey grass lands, when the same are broke up, so as to expose the greatest surface to the influence of the sun and atmosphere, and has illustrated the same by a diagram, shewing the manner in which each furrow or sod should rest on edge against that last ploughed, instead of being turned flat over, by which a corner of each sod is presented on the surface, to increase the exposure; and cavities are preserved, underneath, for some time, for the more effectual drainage and amelioration of the soil. Nine inches broad, and three and a half

inches thick, are supposed by Mr. A. to be well-proportioned furrows; there is however this obvious mistake in several of the furrows of Mr. A.'s diagram; that their centre of gravity falls beyond the corner on which they are supposed to rest; and they must therefore have fallen back into their former place, after the plough. Dr. *Andrew Coventry*, professor of agriculture in Edinburgh university, has recommended, that each furrow should be turned over within about 40°, as is explained by an engraving in the Agricultural Magazine, No. 73.

On Draining.—Com. Bd. Agr. 1805.

The fen lands, which lie below the level of the adjoining rivers or of the tide, have hitherto been cleared of their rain and sock-age water, by wind-machines, which are subject to great interruptions from calms and frosts, by which, often, the lands remain flooded, too late in the spring for the summer crop. Mr. *E. Savory*, jun. has recommended the use of steam-engines instead of wind-machines; and states, that a 20-horse engine would cost about 1500*l.* and consume about 20 bushels of coals in 24 hours; and he concludes, that a great saving would accrue in the first expense, and afterwards in attendance and repairs, by the adoption of steam-engines.

Observations.—The water is raised in the present fen-mills, by reversing the operation of an undershot water-wheel, whose floats move in a trough nicely fitted thereto; and, by the power of the wind-machines above, they force the water before them to an elevation of two to four feet, as may be wanted. We are unable to gather from Mr. Savory's communication, whether he proposes to substitute pumps or any other hydraulic contrivances, instead of the water-wheel: and we do not see how, without expensive buildings and great waste of steam, or heat from the fire-place, that the water is to be prevented from freezing and clogging the machinery during an intense frost; a circumstance on which a great part of the advantages of Mr. Savory's proposal are made to rest.

Mr. *Samuel Taylor* has communicated some useful observations on surface draining, as practiced in Norfolk, Hertfordshire, &c. and judiciously recommends ling, or heath *(erica vulgaris)*, as the best substance to fill the drains in arable land with, where it can be easily procured; and where this is not to be got, ropes slightly twisted of wheat or pea straw, or small brushwood, are recommended.

On Manuring.—Com. Bd. Agr. 1805.

UNDER this head, several different agriculturists have communicated their practice, or their opinions, on the use of lime in a caustic state, lime slacked in compost, marle or white malm, clay marle, bone-dust, soot and sea-weeds; and besides the burning of stubble, noticed in our last Number, Mr. *William Pontey* has stated the great benefit derived from strewing a piece of dry fallow land six or eight inches thick with the shellings or husks obtained from oats in the manufacture of oatmeal, and setting the same on fire. An experiment on evaporating a solution of nitre is related by Mr. *John Martin*, who, finding the quantity of nitre left, when the water was exhaled, to be the same as was at first dissolved, concludes, that the watery parts only of dung are dissipated, when the same is spread and not soon after ploughed into the land. We have noticed this, as conceiving it to be contrary to the opinion of most good farmers; among whom we may reckon Mr. *William Payne*, the author of the last communication printed on this subject. We should have thought, that the nose of any person, who had walked through, or to leeward of a newly spread field of dung, would have taught such, that something more than water was exhaling: and we may add, that the avidity with which soils (except those already profusely manured) imbibe these fetid gasses, is an indication of the importance of quickly covering dung, when spread on fallows, as also of keeping dung-hills covered with a thin coat of mould (as is well remarked by Lord *Meadowbank*, in a subsequent communication). It may be of use also to add, that the offensive smell of privies may be almost entirely prevented, by sprinkling in a small quantity of mould daily; and that much valuable compost will be thereby formed, which can be afterwards taken out and spread on the farm, without the usual disagreeable smell. Mr. *Morris Birkbeck* has in these communications stated, that land will not be exhausted under tillage, if the whole of the manure made from consuming the crops be applied thereto: under a judicious rotation of crops this is true; but it is not less true, that land may be greatly, if not entirely exhausted, by successive crops of white-strawed grain, although all the dung produced therefrom is applied on such land.

Mr. *John Wright*, of Pickworth, in Rutlandshire, on a reddish gravelly soil, mixed with limestones and a few pebbles, incumbent on a limestone rock at 12 inches deep, tried several comparative experiments, under the direction of the Board, on the effects of the soil without manure, with dry straw burnt upon the land (as mentioned in our second Number), with long straw

dung, and with rotten dung; the produce of turnips was, 0t. 1c. 8lb.; 8t. 3c. 7lb.; 18t. 6c. 6lb.; and 16t. 1c. 4lb. respectively per acre: the next crop, of barley, on one ploughing, produced 14 bus. 3 pecks; 30b. 1p.; 30b. 2p.; and 36b. 3p. respectively: the succeeding crop of clover-hay weighed 8cwt. 18cwt. 20cwt. and 21cwt. respectively per acre. Another experiment was made on a poor gravelly soil, worth about 10*s.* per acre; three parts of it being manured with different proportions of burnt straw, long dung, and rotten dung, and sown with beans and peas mixed, the produce was 7 bus.; 8b. 1p.; 9b. 1p.; and 9b. respectively per acre: the next crop was wheat, and the produce 14b.; 14b. 1p.; 14b. 1½p.; and 14b. respectively per acre. A third experiment was made, on the same soil, manured as the last, and set with potatoes: the produce was 76b.; 101b.; 82b.; and 97b. respectively per acre; the produce of wheat next year in this case was 14b. 1½p.; 17b. ½p.; 16b.; and 15b. 2½p. respectively per acre. Mr. *Wright* observes, "It is a pleasing reflection, that crops of potatoes and turnips may be procured with offal straw, when a farmer has no other manure." We are happy to learn, that these courses of experiment are yet going on.

The Rev. *Robert Duncan* justly complains of the great waste of straw in thatching buildings, and of the loss which agriculture sustains, from withholding so much of manure from the land, in situations where slates can be readily procured as a substitute. The increasing taxation on tiles will, we fear, long operate to prevent any general abandonment of thatched buildings.

Dr. *Belcher*'s observations on urine, as a manure, shew the great importance of *soda phosphorata* and of *ammonia phosphorata*, which are found in urine, as manures; these products of urine were used in very small quantities, to manure pots of sifted gravel from Epping Forest, sown with garden cress, on the 11th of August; and on the 27th of September, the plants in an unmanured pot were found to weigh 40 grains, the soda phosphorata pot gave 180 grains, and the ammonia phosphorata 188 grains. Dr. *Belcher* laments, that modern farmers suffer so much of the urine of their cattle to flow away, and frequently also have their dung-heaps so situated, that they are drenched and impoverished by rain, which conveys their most valuable ingredients into the next river.

The Rev. *Edmund Cartwright* has made a comparative set of experiments, on a piece of ground called the Evergreens Nursery in Woburn Park; being a ferruginous sand, brought to a due texture and consistence, by a liberal covering of pond mud; on an analysis thereof, 400 grains gave,

	grains.
Of siliceous sand of different degrees of fineness, about	280
Of finely divided matter, which appeared in the form of clay	104
Loss in water - - - - - - - - -	16
	400

The 104 grains of finely divided matter contained of carbonate of lime - - - - - - -	18
Of oxide of iron - - - - - - - -	7
Loss by incineration (most probably from vegetable decomposing matter) - - - - - -	17

The remainder principally silex and alumine.

There were no indications of either gypsum or phosphate of lime.

Mr. *Carturight* observes, "It will appear from the above analysis, that the following experiments could not, perhaps, have been tried on a soil better adapted to give impartial results; for of its component parts there is no ingredient (the oxide of iron possibly excepted), of sufficient activity to augment or restrain the peculiar energies of the substances employed."

On the 14th of April 1804, twenty-five beds of this soil, each one yard wide and forty long, were laid out, and manured, as follows, viz.

No. 1. No manure.
2. Salt, $\frac{1}{4}$ peck.
3. Lime, 1 bushel.
4. Soot, 1 peck.
5. Wood-ashes, 2 pecks.
6. Saw-dust, 3 bushels.
7. Malt-dust, 2 pecks.
8. Peat, 3 bushels.
9. Decayed leaves, 3 bus.
10. Fresh dung, 3 bushels.
11. Chandler's graves, 9lb.

N. B. The quantities of each ingredient in the next column, the same as when used singly.

No. 12. Salt and lime.
13. Salt, lime, *sulphuric acid*
14. Salt, lime, peat.
15. Salt, lime, fresh dung.
16. Salt, lime, peat, *gypsum*
17. Salt, soot.
18. Salt, wood-ashes.
19. Salt, saw-dust.
20. Salt, malt-dust.
21. Salt, peat.
22. Salt, peat, *bone-dust.*
23. Salt, decayed leaves.
24. Salt, *peat-ashes.*
25. Salt, chandler's graves.

On the above day, each bed was planted with a single row of potatoes, care being taken to use the same number of sets in each.

On the 21st of September, the potatoes were all taken up and weighed, and the produce of each bed found as follows, viz.

No.		lb.
17.	Salt and soot . . .	240
11.	Chandler's graves	220
18.	Salt, wood-ashes . .	217
16.	Salt, lime, peat, *gypsum*	201
15.	Salt, lime, fresh dung	199
2.	Salt	198
25.	Salt, chandler's graves	195
4.	Soot	192
10.	Fresh dung . .	192
20.	Salt, malt-dust . .	189
5.	Wood-ashes .	187
23.	Salt, decayed leaves	187
24.	Salt, *peat-ashes* . .	185
7.	Salt, malt-dust . .	184
14.	Salt, lime, peat . .	183
19.	Salt, saw-dust . .	180
22.	Salt, peat, *bone-dust* .	178
9.	Decayed leaves	175
13.	Salt, lime, *sulphuric acid*	175
21.	Salt, peat	171
12.	Salt, lime . . .	167
8.	Peat	159
1.	(no manure)	157
6.	Saw-dust . .	155
3.	Lime . . .	150

The foregoing table furnishes, says Mr. C. many particulars worthy of observation. In the first place it is remarkable, that of ten different manures (Nos. 2 to 11) most of which are of acknowledged efficacy, salt, a manure hitherto of an ambiguous character, is superior to them all, one only (No. 11) excepted! And again, when used in combination (Nos. 12 to 25) with other substances, it is only unsuccessfully applied in union with that one (No. 25), no other manure, seemingly, being injured by it. Possibly its deteriorating effects on chandler's graves, may be owing to its antiseptic property, which retards the putrefactive process, by which animal substances undergo the changes necessary to qualify them to become the food of plants. This however, I cannot, says Mr. C. from any appearance in the soil when the plants were taken up, assert to have been the case. The extraordinary effects of salt, when combined with soot (No. 17), are strikingly singular. There is no reason to suppose these effects were produced by any known chemical agency of soot or salt on each other. Were I to guess at the producing cause, I should conjecture it to be, a property of saline substances, by which *they attract moisture* from the atmosphere; for I observed those beds, where salt had been used, were visibly and palpably moister than the rest, even for weeks after the salt had been applied; and this appearance continued till rain fell, when, of course, the distinction ceased. It may be proper to observe, that on those beds where salt had been used, the plants were obviously of a paler green colour than the rest, though not less luxuriant. Also, that where salt was applied, whether by itself, or in combination, the roots were free from that scabbiness which oftentimes infects potatoes, and from which none of several other beds in the same field were altogether exempt.

Observations.—We are unable to discover any reason for the different quantities of the substances used alone in Nos. 2 to 11, or whether we are to understand that Nos. 12, 17, 18, 19, 20,

21, 23, and 25, had double portions, and Nos. 14 and 15 treble portions of manure, or only single portions of a proportionate mixture: with respect to Nos. 13, 16, 22, and 24, we are still more uncertain, having no indication of the quantities of sulphuric acid, gypsum, bone-dust, or peat-ashes used. We understand, that a material circumstance has been forgotten in the description of the soil on which this experiment was tried, viz. *its extreme dryness*, being on the top and within 100 yards or less, of the steep edge of a loose stratum of clean sand, which holds no water, until you have sunk between 30 and 40 feet below its surface: it appears also, from a meteorological journal kept in the neighbourhood (see Monthly Mag. xviii. 99, and xix. 317), that the fall of rain was, in April 2.30, in May 1.82, in June 2.00, in July 2.25, in August 2.17, and in September 0.24 inches, the monthly mean of this year being 1.97, and of the last five years 1.94 inches. We have little doubt, but the affinity which *salt* has for moisture, occasioned the comparative superiority, in these experiments, of the crop on the beds wherein it had been used, and even in some, counteracted the deteriorating effects which would otherwise have appeared: this receives some confirmation from the result of two other experiments near the same place, which are mentioned by Mr. C. and were similarly situated, except that, being on land till lately a common, the soil here had received no stiffening from ancient marling and manuring, or from modern mudding, as in the above case; and where, neither turnips nor buck-wheat could be kept alive in July and August by any of the above twenty-four manures, although more rain then fell, than is usual in these months. The subject is an important one, and we hope that the Board of Agriculture will be able to enrich their next volume with comparative experiments on salt, as a manure for *moist soils*, and different situations. The experiments by the above gentleman, on the effect of salt, when mixed with the food of hogs and cows, having in his opinion led to no conclusive results, it is unnecessary for us further to notice them.—See our account of Mr. Young's experiments on salt and many other substances as manures, page 118, in our first Number.

On burning Lime.—Com. Bd. Agr. 1805.

Mr. *T. G. Rawson* has given a description of his improved lime-kiln, which, though accompanied by a sketch, we are unable to understand: we learn, however, that Mr. *Rawson* has applied a metal boiler and two ovens in the side of his lime-kiln, in which the victuals for his servants are dressed; the heat from his kiln is also made to kiln-dry his corn, &c.

Mr. *John Dodgson* has communicated the result of his experience, in burning lime for manure with peat, in what is called a running kiln; Mr. *Dodgson* says, "The quickness of the process with peat is surprising, for in twelve hours after I put fire to the kiln, I have lime ready to draw; in burning with coal, none can be drawn for two or three days; and nearly double the quantity of lime is produced every succeeding day, than can be with the use of coal, owing to the peat keeping the limestones in an open porous state, and admitting a brisk circulation of air; for the same reason the limestones cannot run into a solid lump, with excessive heat, as sometimes happens with coal." Half-dried peats will burn lime as well, but not quite so expeditiously as dry ones. Sir *William Maxwell*'s tenants near Dumfries had, it appears, practised the burning of lime with peat, before Mr. *Dodgson*.

Observations.—We are not acquainted with the nature of the Bewcastle peat, in Cumberland, which Mr. *Dodgson* used: the ochry peats of Bedfordshire throw off, as we are informed, such a quantity of sulphuric acid while burning in a clamp, as to burn up and destroy the grass to leeward, for a considerable distance: a considerable quantity of gypsum would probably be formed from limestone or chalk, burnt by such peat; and it would on that account be interesting, to know the effects of lime so burnt, and used for manure.

Lord *Meadowbank*'s observations on lime as a manure, in this volume of Communications, contain much valuable information. *Farmer Sandy*, a correspondent of the Agricultural Magazine (No. 76), has made some observations on the use of slacked lime as a manure, in Roxburghshire.

On different Crops introduced on the Breaking up of Grass Lands. —*Com. Bd. Agr.* 1805.

In the numerous communications which the Board have printed, on wheat, oats, beans, winter tares, turnips, potatoes, carrots, cabbages, rape, hemp, flax, and woad, much valuable and practical information will be found; and on the courses or rotations of crops: as also on cocksfoot grass, perennial rye-grass, Yorkshire white *(holcus lanatus)*, creeping soft grass *(holcus mollis)*, mixtures of natural grasses, thrashed hay-seeds, clovers, sainfoin, rib-grass, parsley, and caraway *(carum carni)*. The number of papers which we have to notice, will not admit of our pointing out many valuable hints on the above subjects; we must not however omit mentioning Mr. *William Jones*'s recommendation, if possible, to sow wheat only in dry weather *; Mr. *James Mal-*

* The Rev. *Nicholas Turner* severely condemns this practice, and ascribes the blighted wheats of 1804 to this cause. Young's An. No. 257.

colm's observations on the great economy of giving green winter tares to the stock in cribs, instead of hurdling off daily portions of the standing crop for them, are entitled to our particular notice; so are Mr. *John Wright*'s on the raising of potatoes, from the shoots which they put forth in the storehouse. Green rape or cole has been found of immense advantage by Mr. *Thomas Cussans* for sheep keep, on land too strong for turnips. It has been truly noted, of the soft grasses *(holcus, lanatus & mollis)*, that they are valuable for sheep feed, if always close fed; at the same time we are required from very considerable experience, to join in the unqualified condemnation of them as a hay-crop, or in pastures not closely fed, in the spring in particular: the early ripening, profusion of seeds, and extreme facility with which the same are shed, render these grasses quite improper to be sown, in pastures intended to be mowed. The experiment in which rib-grass *(plantago lanceolata)* was used, terminated as we should have expected: our experience leads to its entire condemnation: where it abounds in pastures mown for hay, the same must be kept abroad in the field, until nearly spoiled, to prevent the broad and fleshy leaves of the narrow plantain or rib grass, from afterwards turning black and moulding in the stack, as almost invariably happens if the weather is at all unkindly. Linnæus, Dr. Withering, and Mr. Dickenson assert, that cows refuse this plant: the latter gentleman mentions twelve acres being sown therewith, which produced a plentiful crop, but which no animal would eat: broad, and particularly *thick* leaved plants, are improper for hay. Mr. *Morris Birkbeck* has made some observations on the grass seeds preserved and found in a dormant state, in the turf or sod of old pasture lands: we hope that some of the many occupiers of lands foul with seedling weeds, will be induced to repeat the experiment, and apply the same mode of reasoning to the clods of their arable land.

Mr. *Thomas Chatterton*'s account of the culture and use of the caraway plant, seems to promise considerable advantage on strong rich soils, not disposed to the natural grasses. On the management of newly sown grass lands, we find practical men not unanimous in feeding the first year; Mr. *John Kiddle* having found a comparative experiment to turn out in favour of mowing the first crop.

On the Feeding of Cattle.—Com. Bd. Agr. 1805.

We find on this subject the practice of Mr. *Rains* mentioned, as one of the first who fatted beasts with straw and oil-cake in Lincolnshire; who also gave cakes to his fatting sheep when at turnips. In another communication, without name, the feeding of calves with powdered oil-cake and bran is recommended.

Mr. *W. West* of Musleliffe farm, near Christ Church, Hants, says, "In the months of October, November, and December, 1798, I gave to my working horses upwards of 700 bushels of haws, or white-thorn berries, with chopped hay and straw, in lieu of corn. Two bushels of berries were equal to one bushel of oats; they were got by old people and children at 7*d.* per bushel. All the horses were fond of them, and performed their work as well as with their usual quantity of corn. My neighbours used them with the same success, as long as there were any to be gotten."

Observations.—In modernly enclosed parishes, and districts, where the hedges are mostly or entirely of white-thorn, the practice of feeding horses with haws may be advantageous, not only in saving of corn, but in preventing the increase of birds to a hurtful degree, and of vermin which live on these berries, in the winter.

Mr. *Thomas Eastcourt* has communicated the particulars of his experiment on twenty sheep, of a mixture between South Down and Wiltshire, rising two years old, in order to ascertain the effect of exposed and sheltered situations, on the feeding of them, in four lots of five sheep each, from the 22d of November to the 14th of March: the results were, that lot I. fed on turnips and hay, in the field where the turnips grew, in the usual way, lost 12lb. in their total weight; lot II. fed on turnips and hay, given to them in a grass field, without any shelter, gained 1lb.; lot III. fed on turnips and hay in a paddock, with a shed to retire to at will, gained 4lb; and lot IV. fed on turnips and hay in a warm open shed, gained 43lb. The weight of each individual sheep, and of each lot collectively, is given at three intermediate periods, viz. December 21st, January 18th, and February 14th; all the four lots, lost weight considerably between the 22d of November and 21st of December, viz. lot I. 37lb.; lot. II. 12lb.; lot III. 15lb.; and lot IV. 20lb.

On Embanking.—Com. Bd. Agr. 1805.

Mr. *John Smith,* of Chatteris in the Isle of Ely, informs us, that until within these few years past, the fen banks in that neighbourhood were made of fen moor and other light materials, through which so much water soaked as greatly to injure the crops, the wheat in particular: that he first practised the cutting of a gutter 18 inches wide, through the old banks down to the clay (the fen substratum being generally clay); the gutter being made near the centre, but a little on the land side of the centre of the old bank. This gutter he afterwards filled up in a very solid manner with tempered clay; and to make the clay resist the

water, a man in boots always trod the clay as the gutter was filled up: the cost was only *6d.* per yard. The success of the experiment was so complete, that a farm whose surrounding banks had been thus treated, was quite dry in the spring, at a time when all the adjoining fens were under water, from the rain and sokage water, exceeding the power of the mills to throw out water.

Observations.—We are truly surprised to hear, that the security which canals have so long enjoyed against sokage, in the *puddling* of their banks, has not been adopted in all the fen banks, whose leakage is at best to be lifted out again by expensive machinery; and may, if the quantity exceeds their means, frustrate the intent, by the loss of the crops.

On Irrigation.—Com. Bd. Agr. 1805.

Mr. *James Ferguson* has communicated a map and description of 41 acres of watered meadow which he caused to be constructed, by a Gloucestershire floater, in Buchan district, Aberdeenshire, Scotland; the expense is stated to be about *9l* per acre, on the average: and certificates are annexed, of the first year's crop.—The Rev. *R. B. Clough* has furnished three maps of his farm at Erivatt, near Denbigh, in North Wales; the last of these, describing particularly a meadow of *29a. 1r. 19p.* therein, which was irrigated in 1802, under a Gloucestershire floater, at the expense of *11l.* 10*s.* per acre in ground-work, and *7l.* 14*s.* for clearing, underdraining, fencing, arches, flood-gates, wears, and part of the other expenses of this meadow. The first map shews the farm in its unimproved state, with a serpentine brook-course through it, occupying and destroying the best part of the land; the second map shews the capital improvements which Mr. *Clough* has made, in cutting a new course for the brook; levelling in its old channel, and the adjoining banks of rough and unprofitable ground; straightening and new quicking most of the fences, making a good road to the house and other permanent improvements, by which *900l.* at the least has been laid out, on about 231 acres of land. We are concerned to add, that so spirited and able an improver is *only tenant from year to year*; and more so, that the Board have let slip so favourable an opportunity of urging to the proprietors of land, the justice and propriety also, of *granting leases* where valuable and permanent improvements are expected or made, without any clauses therein, which a law-agent may afterwards unfeelingly use, to wrest the possession from the improving tenant, or his widow or children after him, during the term. One cruel instance of the kinds we

have hinted at, will do more to discourage great improvements, than all the revenues of the Board, applied in premiums for years after can counteract. It is not to gentlemen, laying out a small portion of their surplus wealth, on land in their own possession, but to the great body of tenantry, making and following up improvements, that the public have to look for an increased production of the necessaries of life; and can any one expect Mr. *Clough*'s conduct to be imitated by tenants at will, who have a proper regard to justice towards their families, creditors, &c. ?—Mr. *Edward Pearson*'s meadow of 2*a*. 0*r*. 19*p*. in Tyddyn-Buck farm, in Llanfachreth, in North Wales, is next described, and a map given; but from which we are at a loss to discover any thing of novelty or merit.—The map of a meadow of nine acres belonging to the Duke of Bedford, on Prisley farm, in Bedfordshire, is also inserted, accompanied by an account of the produce therefrom in 1803 and 1804. A note to this article informs the reader, that this farm is in occupation of *the Duke of Manchester, who formed this meadow*. From a person who attended the agricultural committee of the Society of Arts in the Adelphi last sessions, we learn, that there is a mistake in this note; that Mr. *William Smith*, of Buckingham Street (late of Bath), was employed to construct this meadow by the late worthy *Duke of Bedford*, and that the same was since his death completed, and two other meadows near adjoining it, of five and six acres, at the expense of the *Duke of Bedford*. Also, that Mr. *Smith* presented to the Society of Arts, a copper-plate map of this nine-acre meadow, which he stated to have been engraved at his own expense to circulate among his friends and employers; and from which, the plate in the communication appears to have been engraved, although we have looked in vain through the volume for his name. It may be interesting to add, that these three meadows were constructed on the bog (the scene of Mr. *Elkington's topping* experiments in 1794 and 5), abounding with *sulphate of iron*, extending into the parish of Tingrith, of which a full account has been given in our first Number (p. 121); that these meadows, particularly the two last, were almost entirely naked black peat without any herbage, when first formed, and that the ochry and thick water which was turned over the same, had a most rapid and surprising effect in producing the *poas alopecurus festucas* and others of the best grasses, which were not before to be found on the bog. Mr. *Smith*, we are told, stated the expense of the nine-acre meadow to have been 16*l*. 10*s*. per acre, of the middle or five-acre meadow 14*l*. per acre, and of the upper or six-acre meadow, on the most uneven part of the bog, 20*l*. per acre.—Mr. *Morris Birkbeck* has stated, in a communication on dormant seeds, that the creeping bent-grass *(agrostis stolonifera)*, and creeping crowfoot *(ranunculus repens)*, were prevailing and excellent herbage in a watered meadow.

On the Blight, Mildew, and Rust in Corn.—Com. Bd. Agr. 1805.

In January last, the worthy President of the Royal Society, Sir *Joseph Banks*, at his own expense caused plates to be engraven, and a considerable impression of his pamphlet accompanying them, to be circulated gratis, for explaining the actual appearances, under the best microscopes, of the disease in wheat, which had so distressingly lessened the produce of the preceding harvest. The extensive circulation which the Board of Agriculture and the various periodical works have since given to this essay, together with the comprehensive view which we have given of its contents in our first Number (pages 105 to 108), render it unnecessary here to repeat the same: we beg however to remark, that Sir Joseph has been properly careful to distinguish therein, what is asserted as fact and matter of information to agriculturists, and what is suggested, and with becoming modesty recommended to them, as matter for future experiment and observation. For want of duly attending to these circumstances, we are sorry to see this laudable effort of the worthy President treated with a degree of severity, and even of ridicule, in some agricultural works, ill calculated to forward the great ends of improvement, which the editors of those works profess to have in view. That intelligent body of practical agriculturists, the Norfolk Agricultural Society, have, we observe, thanked Sir *Joseph Banks* for his treatise.—Mr. Arthur Young (Annals, No. 257) has continued his laudable inquiries and information on this subject (see our first Number). Among Mr. Young's correspondents, Mr. Benjamin Cotton, the Rev. Michael Turner, Mr. Thomas Simpson, Mr. John North, Mr. Thomas Pickford, the Rev. Henry Hill, and others, agree in thinking, that the frosty nights in June 1804 were the predisposing cause of the blight which followed, and which was more general and hurtful than in any year since 1725. Mr. Pickford mentions the cold air having cut off the young fern *(pteris aquilina)* in the vallies only; we remember some years before to have noticed the same thing, and to have observed every ditch and low place to have been affected, as it would have been by the running of a stream of water or other heavy fluid. Mr. Edward Gwilt, Mr. Thomas Pickford, Mr. William Payne, Mr. Pen Williams, and others, remark, that fogs, blue mists, and still weather, preceded the appearance of the disease on the wheat straw. Nearly all of Mr. Young's correspondents agree in the advantage which was reaped from early cutting of the blighted wheat; Mr. Cotton, in particular, relates a case of 100 sheaves of corn being cut to make a road to another field, when the

kernel was scarcely filled with milk, and when the same was quite soft; three weeks after, the remainder of the field was cut, and the corn from the early cut sheaves proved by much the plumpest and best sample. It has been observed, that wheat cut thus early should remain longer than usual in the field, before it is carted to the barn or stack.—An intelligent correspondent of the Agricultural Magazine (No. 76), Agricola Northumbriensis, relates his having sown part of a field with thin or offal wheat, and found the produce thereof as good as from the plump seed with which the remainder of the field was sown. In other points this correspondent has ably supported Sir Joseph's observations. In the Farmer's Magazine (No. 24) we have a proposition for setting apart farms, for raising new varieties of seed corn, by a proper attention to selection for several years.

On Insects hurtful to Corn and Turnip Crops.

Mr. *Thomas Marsham* has examined some specimens of wire-worm, sent to him by Mr. Young, and found them to be the *elater segetis*, particularly described by C. Bierkander, from whom an extract is given in the *Com. Bd. Agr.* 1805. This destructive insect continues, we are told, for *five years* in the larva or grub state, and during that period feeds on the plants of corn or grass: it is remarked, that while fields lie fallow, it subsists on grass and other vegetables; and that the crops on those fields suffer the most, whose fallows are most infested with couch-grass and weeds. The picking up of these worms by children after the plough is recommended as the best way of destroying them.—A correspondent, B. in the Farmer's Magazine (No. 23), has given an account of the turnip caterpillars, which he found on the 23d of July last, and put into a box with turnip, pea, potatoe, rose-cabbage, radish, bean, and lettuce leaves, but the caterpillars eagerly seized the turnip leaves in preference to all the others, and when these failed them, the cabbage and radish leaves were next attacked. On the 3d of September, some of these produced winged insects, or flies, with orange-coloured bodies, six legs, black heads, with two horns each; the wings longer than the body.

On the Culture of Beans.

John Christian Curwen, Esq. has communicated to the Board of Agriculture the result of his experiments on drilling beans at twenty-six inches apart, on forty acres of a stiff clay soil;

which, after being repeatedly horse-hoed, were cut on the 20th of August, *when quite green*, and removed to an adjoining pasture field, where they were spread thinly for two days, and then bound up; after which they remained three weeks in sheaf, before they were stacked. Two ploughings, harrowings, &c. were then given to the land, and in some parts three ploughings; sixty loads of compost per acre were spread, and wheat was drilled thereon, and completed by the 20th of September!—A correspondent, T. S. S. in the Farmer's Magazine (No. 23), has remarked, that beans, from bearing their seeds on the side, instead of the top of the stalk, will not admit of sowing or drilling so thick in proportion as wheat, barley, &c. without suffering for want of sun and air; and that a single stem of beans will be more productive than a group of such stems, while the reverse is the case with the other sorts of grain.

On the Culture and Consumption of Carrots.

The Rev. *Arthur Young* (son of the Secretary) has communicated to the Annals of Agriculture (No. 257) the account of eight acres of good sandy loam, friable and dry enough for turnips, substratum a gravelly loam, on which 5 lb. of carrot seed per acre was sown, in the last week in March: all expenses, including rent, taxes, tithe, &c. amounted to 8*l.* per acre; the produce was 545 bushels of carrots per acre: the greater part of these were sold at 7*d.* and 8*d.* per bushel, and the rest consumed by horses, pigs, bullocks, and a cow; and, reckoning these at the same rates, the net profit was 6*l.* 15*s.* 7*d.* per acre, and the land left in capital order for barley. The experiments are detailed at length, on the increase in weight of seven different lots of pigs fed in part, or wholly, on carrots: we cannot attempt to give the result of these varied experiments; one of which had for its object, a comparison of Swedish turnips, cabbages, and carrots, in the feeding of pigs.

On the Feeding of Horses and Oxen, &c.

Mr. *Thomas Fisher*, in his communication to the Board of Agriculture, has given an account of his practice for seven years past, in keeping three horses, for managing fifty-three acres of land. A four-acre field near the house is appropriated for horse-keep; each year one acre is a fallow crop, set with black potatoes by the plough; another acre is barley, laid down with 14 lb. of red clover, and half a bushel of rye-grass seed; a third acre is

clover and rye-grass, cut green for summer food; and the fourth acre wheat (or, sometimes for change, oats), after clover. The potatoes are clean washed each morning for the day's use; each feed is given to the horses after their water, twice or three times a day, according to their work: the clover is cut fresh every morning, and given three times a day; the clover land is always cut twice over, and sometimes three times, and then ploughed in for wheat or oats.—Mr. *Robert Brown* has communicated to the Farmer's Magazine (No. 24), an account of the feeding of twenty-four Aberdeenshire stots, which, after being wintered on straw and a few common and Swedish turnips (valued at 32*l.* 15*s.*), were on the 1st of June put to green clover, mown and given in troughs and cribs, the offal being removed frequently and thrown to the swine in the yard: about the end of July, green tares were mown and given to them, until the second crop of clover was ready for the scythe: the cattle were sold off on the 10th of August and 13th of September, and fetched 366*l.* 13*s.* leaving 106*l.* 7*s.* profit; which Mr. Brown estimates to have paid thus: for six acres of clover at 12*l.* two acres ditto at 8*l.* one acre of tares 8*l.* 7*s.* and two acres ditto at 5*l.* The tares were sown at different times, so as to come in in succession; and it is remarked, that cattle for home-feeding should be in decent condition, when grass is first given to them; otherwise the month of June, the richest time of the grass, will be passed over before much improvement can be discovered: it is desirable to have the main part of the beasts ready for the butcher by the time the first crop of clover is become hard and unpalatable.—Mr. Nehemiah Bartley, Pastoris, Agricola Northumbriensis, and a Novice, have been engaged in a controversy, in several of the late numbers of the Agricultural Magazine (which seems not yet terminated), on the comparative merits of potatoe and turnip crops for feeding sheep. See our account of Mr. Robert's experiments on this subject, at page 116.

On Dairying.

Mr. *George Cathery* has communicated to the Board of Agriculture (1805, vol. iv.), and given his opinion, that meadow land, worth 40*s.* per acre, will keep a cow on two acres and a half; each cow will give two gallons of milk for twelve months out of thirteen, allowing one month to be dry; and that a loss of 87*l.* would be incurred, by breaking up twenty acres of such meadow, and cropping it with potatoes, wheat, turnips, and wheat and grass-seeds in succession, instead of letting it remain in dairying pasture.—Mr. *Thomas Best*'s communication favours the above result, and mentions the practice of Somerset and Dorset, in

letting their cows to dairy-men, instead of the farmer making butter or cheese himself. Ten or eleven pounds per annum is mentioned, as the usual hire of a cow for milking, the farmer finding food, but the dairy-man attends on the cows.—Mr. *John Conyers* has answered the inquiries of the Board on the subject of dairies: whence it appears, that he prefers the North Devon cows, as not treading the land so hurtfully as the Herefordshire; as most disposed to fatten after milking, as giving the most milk, and being in other respects preferable to the other breeds of cows. One acre of very good pasture will suffice for a cow, of middling pasture 1½ acre; one ton of hay, or rather less, will be consumed by each milking cow in the winter months. Upon an average ten cows give five dozen pounds of butter per week in summer, and two dozen in winter; and a profit of 13*l.* 14*s.* per cow is sometimes made in a year. Old pastures are found to yield the best butter; and soap-ashes to be the best manure for such. Skimmed milk is sold to the poor by Mr. *Conyers* at 3*d.* per gallon; or their pigs taken in to fatten at 3*s.* 6*d.* to 4*s.* 6*d.* per week. The consumption of fuel is among the most considerable expenses of a dairy, and the hedges are often kept full of hurtful pollard trees to supply this consumption. It is not until the second week in May, that there is natural grass enough in the field in general, for cows to subsist on.

On Potatoe Fallows.

Mr. *John Cotes* has communicated to the Board of Agriculture, the particulars of a method of raising potatoes on strong soils, in rows, at sufficient distance from each other, to admit of working and fallowing the land between them, in order to sow the whole afterwards with wheat.

Observations.—We have no idea, that the great advantages would follow from this practice, which Mr. *Cotes* predicts; the method itself, is but an extension of the well-known practice of drilling and horse-hoeing, scuffling, &c. between the rows. It certainly would be better to cultivate potatoes by themselves in a field, or part of one, in the usual way, and to fallow the land effectually; cross-ploughings, which are often essentially necessary on strong land, could not be applied to the potatoe fallows, nor effectual harrowing, rolling, &c. unless the rows were at such a distance from each other, as would render the produce of potatoes of no account.

On Inclosing.

We are glad to observe Mr. Secretary *Young* continuing his researches into the effects of parliamentary Inclosures. In the Annals, No. 257, we are presented with minutes taken on the spot, in several parishes in Huntingdonshire, inclosed within the last forty years. The general *expenses* of several of the inclosures are given, and are well worthy the attentive perusal of those concerned, or about to engage, in the alarming expenses of modern inclosures. The practice of commissioners in sowing clover with the breach crop, is commended by Mr. *Young*. We are sorry to observe a practice gaining ground with commissioners, of not making any rate on the proprietors (for fear they should grumble), until after the allotments are set out; by which the roads, drains, and other public works which the commissioners ought themselves to superintend, are left to be performed after they have done, or many expensive meetings are afterwards unnecessarily held, for them to superintend the roads, &c. Clover is often not sown, because no money has been raised under the act, for purchasing seed, or other useful and general purposes of the inclosure. We submit to the worthy Secretary, the propriety of compressing his lists of births and burials in inclosed parishes, into less space; smaller type, and two columns in a page of the Annals, might afford to practical farmers, more useful information than this, or the number of religious sects in the parishes. It is not without regret, that we see Mr. *Young* in so many instances retailing the complaints of the cottagers in newly inclosed parishes, and supporting them by arguments and remarks of his own, which seem to insinuate, that cottage allotments for common-rights, ought to be given to *the tenants* instead of *the owners* of the cottages. Not a doubt can remain, that inclosures have a tendency to increase the quantity of human food in an amazing degree; and that they are beneficial to the industrious poor, as well as to their landlords and the farmers. See Mr. *T. B.*'s observations on the advantages of inclosing, Farmer's Magazine, No. 24.—Mr. *John Carpenter* has, in the Agricultural Magazine, No. 74, mentioned his process of raising quick-sets for planting hedges, from the haws, as also from cuttings of the roots of quick; which when bedded out, are found to vegetate vigorously: in the same Number we are told, that Mr. *Samuel Taylor* has raised white-thorn hedges from the cuttings of the roots of this plant. We have long ago practised the planting of shoots which came up plentifully, from the fibres of the roots left in the ground, after stocking up white-thorn hedges. We can also add, that the best way of renovating a worn-out white-

thorn hedge is to bare the earth, and chop off the large old stools with a sharp axe, near to, or below, the lower fork of the stems; each one of whose roots will afterwards be found to throw up vigorous shoots, and much thicken the future hedge, if the same is thoroughly protected from cattle, and kept clean from weeds.

Rewards to attentive and skilful Shepherds.

Lord *Somerville*, the Duke of *Bedford*, Mr. *Coke*, and several of the Agricultural Societies, have of late given premiums for encouraging a vigilant attention by Shepherds to the rearing of young Lambs. It appears from the Annals, No. 259, that at the late Woburn sheep-shearing, John Holland on the 1st of June produced 390 ewes with 522 lambs; and that Charles Paine had, on the same day, 606 ewes with 745 lambs. At the late anniversary of the Norfolk Agricultural Society, we find the following rule adopted, for ascertaining the numbers x, expressive of the comparative merit of shepherds. From the number of ewes put to tup, deduct the number of ewes which proved barren, call this b; from the number of lambs preserved, deduct the number of ewes lost, call this a; then say, as $b : a : 20 : x$; hoggits not to be deemed stock-ewes. This rule appears to us very defective, since it takes no notice of the different risks, with which lambs (especially double couples) are raised, by the two-year old, three-year, and full-mouthed ewes, which there may be in the same or different flocks, whose shepherds are candidates: if the loss of ewes is meant to be included, in a conclusion on the shepherd's care and judgment in managing his flock, surely the deduction of one lamb for each ewe is not sufficient. We cannot discover, how the Norfolk Society have adhered to their own rule, in the late adjudication of their prizes to shepherds. We have often lamented the want of a set of correct principles or rules, on which the decisions of committees or judges in ploughing-matches, and the above, and some other trials of skill or excellence in rural affairs, ought to be determined. The time of some mathematician, who has a competent knowledge of agricultural facts, would be well employed, in developing the true principles and method of calculation, in the various cases which occur in our societies and agricultural fêtes; where often, less perfect data are obtained, than could be had with the same trouble, and even where perfect data are obtained, the decisions are in too many instances but the effect, of guessing, the judgment of the eye, or perhaps of chance, for want of a knowledge in the judges, of the proper use that should be made of the facts.

On Irrigation.

In the Annals of Agriculture (No. 257) we have a map of Mr. *Joseph P. Cowley*'s watered meadow of 12a. 3r. 6p. in the parish of Aspley, Beds, constructed at the expense of 3*l.* 10*s.* per acre, for which a premium of twenty-five guineas was presented to him by the Duke of Bedford, at his late sheep-shearing. It is remarked, that this meadow is not constructed on the best system; that is, with raised ridges or beds, so that the water may run very briskly off; the smallness of the cost is, we think, a sufficient indication of this circumstance. On inquiry, however, of those who have examined this meadow, we are inclined to think, that the expense incurred has been wisely apportioned to the circumstances; Mr. *Cowley* being only tenant to the land, the supply of water but small, and even the use of this is liable to be disputed, by a neighbouring miller. It is acknowledged, that a poor and unprofitable piece of land is converted into a productive and useful auxiliary to the farm on which it is situate; and we heartily wish, that similar instances were more numerous throughout England.—Mr. *Edward Beck*, of Lexham, has received both the first and second premium, offered last season by the Norfolk Agricultural Society, for nine and four acres at the least of water-meadow, constructed on the best principles: these we understand were made for Mr. *Beck*, by Mr. *William Smith*, before mentioned, on boggy land, with success as striking and singular as at Prisley in Bedfordshire.—In the Farmer's Magazine (No. 24) we find a summary of the principles and practice of Mr. *Charles Stephen*, a noted irrigator, in setting out and forming meadows for watering; six yards is mentioned as a proper medium width for the beds, such having a fall transversely of one inch in a yard.—The practice of *John Upton*, a cottager, in Worcestershire, is very properly commended in the Agricultural Magazine (No. 75), by Mr. *John Carpenter:* this intelligent labourer, by irrigating his small piece of land, *not quite half an acre*, has, on the average of several past years, obtained a ton and half of hay, at two cuttings (sometimes sold at 4*l.* 10*s.* per ton), and let his after-math for a guinea to a neighbour!—We never travel the great roads in this kingdom after rain, without lamenting at every quarter of a mile almost, the sight of so much water running wastefully into the neighbouring ditches and brooks, richly charged with the choicest particles of manure, from the dung of the horses and cattle, the dust of the road, and even the kennels and sewers of a town in some instances; here and there only can we see the common sense of the occupiers of the adjoining lands exercised, in turning the same over their pasture land; wherever this has been done, by a set of irriga-

tion-carriages and drains, so contrived that the water can be frequently changed from one pane or bed to another, the most surprising advantage has resulted.

On the Culture and Preservation of Turnips.

A spirited controversy has for some time past been carried on in the Agricultural Magazine, between Mr. *John Carpenter* and *Farmer Slouch*; the former affirming, and the latter denying, that good crops of turnips can be raised by culture alone, without manuring. It must be needless for us to point out to practical farmers, on which side the weight of argument has hitherto preponderated.—In No. 75, Agr. Mag. we find a letter by *Agricola Northumbriensis*, on the comparative produce of drilled and broad-cast turnip crops; he states, as the result of his own experiments, that the produce, under the Northumberland mode of culture, is to that under the broad-cast method (all circumstances as to soil, condition, manure, time of sowing, &c. &c. being equal), *as four to three*, nearly.—*Agricola Norfolkciensis* has given the particulars, in the same Number, of his experiment on cultivating turnips in the broad-cast way, and in drills on raised ridges; for securing an equal distribution of the seed in the broad-cast, instead of sowing the same by hand: Cook's drill machine was used without coulters, merely walking it over the ground, the cups delivering the seed not into funnels, but upon a piece of stiff pasteboard inclining downwards, which effectually scattered them in the most even proportion over the whole surface: the produce was in favour of the Northumberland method, *as four to three and a quarter nearly*.—In the following Number, a letter from *Agr. Northumb.* will be found, containing many judicious observations on the proper management of comparative experiments like these.—In the Farmer's Magazine (Nos. 22 and 23), a correspondent, *Rr.* has written largely on the northern turnip-husbandry, with the intention of explaining the same, in two letters to a friend, who is no farmer, and yet is desirous of learning, to be able to direct the common farm servants of the country, in practising this essential branch of good farming. The necessary implements are first explained, then the soils most proper for this purpose, the same to be ploughed in the autumn, and carefully water-furrowed; in the spring to be cross-ploughed, harrowed, rolled, and hand-raked or picked, to clear it most carefully from root-weeds: these operations, if necessary, to be three or four times repeated, taking care, if the season permits, that the seed-weeds are allowed to shoot, but not to grow and overshade the land between each working: the weeds and pickings are re-

commended to be carted to a compost heap, and lime added thereto, to rot them, instead of burning them upon the land: lime is then to be applied, if this manure is intended to be used; the method of forming the drill ridges, and applying well-rotted dung therein, is next described; then the sowing of the seed, 2 to 3 lb. to the statute acre; the different kinds of turnips are mentioned: horse-hoeing the intervals, hand-hoeing the drills, and hand-weeding, where necessary, are next recommended, so as to set the plants out singly; two successive horse-hoeings, hand-hoeing at the same time, if necessary, and moulding up, are described. Directions for raising turnips on strong soils next follow. The directions in the second letter, for the consumption of a turnip crop, and the subsequent cropping of the land, are worth attention. The author observes, that on every well-conducted farm, there ought to be some rules or principles of management; one of which ought to be, to have as much of the land in turnips as can be properly worked and manured; a second, to keep as much of the land in grass pastured by sheep, as will be profitable; a third, never, upon any account, to have two white corn crops in succession.

It appears from the Annals of Agriculture, No. 257, that the Norfolk Agricultural Society have rewarded Mr. *John Repton*, and published his method of packing or preserving turnips in the field: the furrows of the land were cleared out with a double-breasted plough, when women and children followed, and pulling up all the turnips for two yards wide on each side, the same were regularly packed into the furrow; a common Norfolk plough then turned the mould from each side over the turnips, so as completely to bury them: the expense is stated at 2*s.* 3*d.* per acre; and, it is said, the turnips will thus be found sound after a severe winter, and will be less liable to shoot and spend themselves in the spring, than such as remain with their roots undisturbed in the soil: that sheep may be allowed to run over and eat the tops of such as may shoot through the covering of mould, without danger of their biting or injuring the turnips beneath.—Sir *George Stuart Mackenzie*, some time ago, offered a gold medal for the best essay on the storing of turnips and ruta-baga, that should be sent in to the editor of the Farmer's Magazine. Mr. *William Panton*'s essay, which gained the prize, will be found in the 23d Number, and contains much useful information on the culture, storing, and consumption of turnips. The method of burying turnips in Norfolk, something like Mr. Repton's above mentioned, is described, but shewn to be inapplicable to the icy regions of the Highlands of Scotland, on account of the difficulty of removing the frozen soil to get at them. It is observed, that some carry off their whole crop, others draw only a third, a half, or two thirds, but most com-

monly every alternate six rows, allowing the other six to remain for hurdling off with sheep: some cut off the leaves in the field, as the turnips are drawn, and plough the leaves in for manure; others cart off the whole plants, and top and tail them at home, giving the leaves while fresh to their store beasts; and not unfrequently, turnips are to be seen put up in ricks, or heaps in the field, without being either topped or tailed: the leaves and root should be taken off close to the bulb, but by no means so near as to wound the bulb, or it will certainly rot: no unsound or imperfect turnips should be put up in the stack. The author of this essay recommends, if the subsoil is quite dry, to dig trenches seven feet wide to store the turnips in, beneath the surface; and in other situations, to build two parallel walls at seven feet distance and three feet high; these to be filled with turnips, heaped up into a ridge, and thatched: 1600 cubic feet is stated to be about an average produce of turnips per acre.—In the following Number of the Magazine we find a long and very sensible essay on this subject, by another candidate, *G.* who concludes thus: "The result of the preceding observations is, that the storing of turnips, abstractedly considered, is attended with direct and unavoidable loss; but, when viewed in reference to the climate and agriculture of Scotland, is necessary in unfavourable situations, and eventually disadvantageous in every other:—necessary in high lands, where the severities of winter prevent turnips from being regularly carried off the ground, to supply the consumpt of cattle; and advantageous, in low lands, by enabling the farmer to introduce wheat after turnips, where he could otherwise obtain only a crop of oats or barley." The author of this essay mentions, that frozen turnips, if put into a brook or pool of water for about two hours, will be found thawed and not at all injured by the frost: a sort of turnip cultivated for some years past in the southern parts of Yorkshire are mentioned, whose bulb is always situate below the surface of the ground; also, a yellow turnip resembling the garden variety, which has lately been introduced into Scotland, by Captain *Mackay*, who uniformly uses them, as an intermediate supply in the beginning of spring, between common and Swedish turnips.

On Anglo-Merino Sheep, &c.

Mr. *Nehemiah Bartley* and *Pastorius* have long been engaged in a sharp contest (not yet apparently terminated) in the Agricultural Magazine; the former gentleman contending, that the Spanish breed of sheep might be profitably extended, in any district or situation; the latter, that new Leicester sheep will yield a much greater profit on good land, and that the Merinos ought to be confined to the middling and hilly pastures in this

kingdom: considerable information, as to the comparative merits of these breeds of sheep, may be gleaned from this controversy.—In the Annals of Agriculture, No. 257, we are told, that Mr. *Tollett* exhibited a wether sheep of mixed breed, between the Merino and South-Down, at Mr. Coke's late sheep-shearing, which had his wool upon him of *three years growth*, the length of which was *from* 13 *to* 16 *inches*; after which, he was shorn and slaughtered, and his carcase exhibited; it weighed 23lb. per quarter; the rough fat within him weighed 15½lb. the skin 6lb. and the fleece 13¾lb.—A correspondent, *J. G.* in the Farmer's Magazine, No. 23, has observed on the practice in some districts, of smearing the backs of sheep with a mixture of tar and other substances, which are found to injure the whiteness of the wool; he asks whether a solution of some gum or resinous substance, with a certain proportion of soda, or other antiputrescent salts or matter, might not be made, which, smeared on the wool, might be more conducive to the health of the animal, than the materials at present in use?

On the Use of the Ass in Agriculture.

Mr. *John Cotton Worthington* has communicated in the Annals of Agriculture, No. 257, an account of his practice, in cultivating 16 acres of land, near Sidmouth in Devon, entirely by the labour of asses. His waggon was extremely light, calculated to carry about a ton and a half, and cost 16*l.* Six asses were harnessed two abreast in it; the harness was a miniature of that of a horse, except that the collar divided at top, like an ox's harness, and buckled together; the pair of chains weighed about 6 lb. at 2*s.* per lb. or 8*d.* per foot; the wheel-harness with hames, pad, iron-work, bridle, breeching, crupper, &c. cost about 1*l.* 16*s.*: the leading ditto ditto, 1*l.* 7*s.*: expenses of shoeing, 1*s.* 6*d.* a round. In all stiff work, four asses were used at plough, harnessed two abreast, and driven in hand with reins by the ploughman. Ten or eleven acres of Mr. *Worthington*'s land in aration, lay on the slope of a hill, so steep that horses had not been able to plough it up and down, but which his ass-team readily performed. The asses, none of which exceeded 11 hands in height, cost 40*s.* or less each: in the same team, stallions, mares, and geldings were used; the mares were found the most gentle and tractable, the geldings most stubborn and inactive, yet the most sagacious: the stallions somewhat vicious, but of double the spirit, strength, and vigour of either of the others. The asses were not found liable to any maladies: were temperate eaters, and throve best when turned out into a neighbouring common to cater for themselves among brambles. The ass was found a deadly enemy to

shrubs, plantations, and underwood, and to young hedgerows whose shoots he could reach. It is mentioned, that Lord *Paulett* employs several ass-teams at Hinton, and even performs his timber carriage by their united efforts.

On the Equalization of Weights and Measures.

A CORRESPONDENT, ⁂ *I.* in the Farmer's Magazine, No. 23, introduces his remarks on this subject, by a mistaken insinuation, as we understand him, that the late attempts of the French to equalize their weights and measures have failed; for we know of no other serious or public attempt of late, to effect this purpose. It should however be understood, that the *old* weights and measures of France are *not* revived, along with their former calendar and division of time. This correspondent very properly, for the mere purposes of agriculture and commerce in the united kingdoms, recommends the *avoirdupois pound* and *Winchester bushel* to be invariably used; but concludes with the same unaccountable absurdity, which has pervaded every English attempt that we ever saw in print, for equalizing our weights and measures in general, viz. giving the *old names* to *new* weights and quantities: this correspondent would, for instance, have 10 *grains* to equal 1 *scruple*; 10 *scruples*=1 *drachm*; 10 *drachms*=1 *ounce*; 10 *ounces*=1 *lb.*; 10 *lb.*=1 *stone*; 10 *stones*=1 *cwt.* No government, however powerful or despotic, could possibly force into general use a system, which must create the endless confusion and mistakes that would arise between such *old* and *new scruple, drachm, ounce,* &c. &c. Inconsiderate or ignorant persons may ridicule the use of new and uncouth names as long as they please, but when *new things* are to be introduced to public use, they must have *new names,* or they never will be understood or distinguished from the things before in use, whose names, by the worst of piracy, are stolen and applied to them. We were truly surprised, after better principles had been adopted with regard to weights and measures, to find the learned men in France falling upon this error, in proposing to divide the natural day into 10 *hours,* the hour into 100 *minutes,* and the minute into 100 *seconds!* the quadrant of a circle into 100 *degrees,* marked ° as at present; the *degree* into 100 *minutes,* marked ′; the *minute* into 100 *seconds,* marked ″; &c. This absurdity is sufficient to account for their never having been adopted in practice, and we can safely assert that they never will be brought into use, unless names and marks, new at least, and somewhat appropriate also, are affixed to each of these new quantities. We are acquainted with a gentleman who had, before the French set about the reformation of their measures and weights, well considered this subject, digested a

plan, procured a number of the proposed new measures and weights to be made; and he submitted the same to some of the best informed men in this kingdom. But the French system being shortly after published in this country, he since desisted from endeavouring to call the attention of the legislature and the public to the subject; not, we conceive, because the French measures and weights appear to him better adapted to the use of this country, but because the mad cry which was set up, against every thing which had been done or attempted in France, however proper in itself, left no room to hope, that our measures and weights could be reformed, while the French were attempting the same thing: when sober sense shall have resumed its reign in this respect, the gentleman alluded to, will, it is hoped, bring forwards, what he conceives, from an extensive knowledge of general business, could be easily accomplished, when seriously undertaken upon right principles.

On draining and improving a Bog.

In the Farmer's Magazine (No. 23) an account is given of Mr. *John Wilkinson*'s improvements on moss land, at Castlehead in Lancashire. It appears that Mr. Wilkinson, who is a great iron-master, purchased this land with a view of making iron from the peat, but found the manufacture of it disadvantageous from the quantity of fuel required, and the difficulty of procuring it in sufficient quantities, especially in rainy seasons: he therefore set about draining and improving this moss for agricultural purposes, which operations are particularly described; and the writer concludes thus: "Narrow-minded and ignorant people endeavour to decry this great and important attempt: they say, that Mr. Wilkinson might have bought, at a cheaper rate, the best land in Lancashire. Perhaps so; but Mr. Wilkinson must derive much higher satisfaction from the plan he has pursued. By so doing, he has furnished employment to numbers of industrious people; he has raised great quantities of food for man, where nothing, but for his exertions, would have been produced; he has shewn a noble example to his neighbours, if they choose to follow it; and, by augmenting the value of 500 acres of a barren waste, from *twopence* to *thirty shillings* per acre and upwards, not merely for a few casual crops, but on the principles of substantial and permanent improvement, he is justly entitled to be ranked among the best friends to the agricultural interests of the country."

On the Progress and Value of Plantations, &c.

In the Farmer's Magazine we learn, that in 1752 Mr. *Stewart* began his planting improvements on Shambelly Hill, New Abbey, in Kirkcudbright, with a plantation of four acres,

of oak, ash, and Scotch fir, which were thinned in 1792 to 1800, and produced upwards of 60*l.* per acre. In 1757, two acres of Scotch firs were planted; there are now 425 trees remaining on an acre, measuring about eleven feet each, which sell at 15*d.* per foot; their value is therefore near 250*l.* per acre. In 1765, 26 acres of Scottish firs, and a few oak and ash, were planted; in 1772, 28 acres of oak, larch, &c.: the present state of these, and several subsequent plantations, will be found in this communication. An oak-tree is mentioned, which produced a ton of bark when felled; and several firs of between 50 and 60 years growth, which measured 40 feet of timber.

Mr. *Nathaniel Kent* lately addressed a letter to the Ipswich newspaper, which will be found in the Agricultural Magazine (No. 74), on the superior advantages of Spanish-chesnut timber. This valuable tree began to be cultivated in Norfolk on an extensive scale in 1676, by an ancestor of Mr. Windham at Fellbrig; in 1726, a limb of one of these, about 13 inches square, was converted to a hanging post, and set down with a gate, which it carried without alteration for 52 years; when, on altering the fence where it stood, it was removed by Mr. Kent, and found perfectly sound, and is now used as a clapping post to another gate. In 1743, a barn was built with chesnut timber from this estate, every part of which is now perfectly sound; several chesnut posts and rails, put down at the time this barn was built, have, after standing 30 or 40 years, been removed, and were found sound enough to be set down again in other places. In 1772, a new plantation was fenced in, with posts and rails, part of oak and part of chesnut; last year, on enlarging this plantation, the chesnut posts were found as sound as when they were first set down; but those of oak were so wasted at the surface of the ground, as to require splicing, or they could not be used again. The quick growth of this plant as underwood, makes it superior to most other sorts of wood for hop-poles, stakes, gates, hurdles, &c.

On Bounties for the Exportation of Corn, &c.

A CORRESPONDENT, *A.* in the Farmer's Magazine, No. 24, has, with some ingenuity and address, combated the objections of Dr. Adam Smith to bounties on the exportation of corn; who remarks, "that till the bounty is sufficient to occasion actual exportation to a considerable extent, it is a dead letter as to expense; but it is not so in another point of view. The farmer, under the conviction that, to a certain extent, a foreign market is open to him, and that his commodity can never altogether remain on his hands, improves and cultivates with confidence. From the flourishing and increasing circumstances of his own

country, which this very cultivation still farther promotes, he finds that he can dispose of his augmented produce at home, which in every instance he will, for his own interest, prefer to any foreign sale, on equal, or even better terms; and the home market will, unquestionably, at all times have the first offer."—*Alpinus*, another correspondent in the same Number, supports this side of the question, by a string of concise and sensible observations on the subject — In the Agricultural Magazine, No. 75, a correspondent, *R W.* in drawing a comparison between the advantages of agricultural and commercial capital, declares against bounties for the exportation of corn: this writer contends, that there cannot for any length of time be any very material difference between the amount of profits on agricultural and commercial capital, from the constant endeavour of every one to make the most of his money; and asks, how, without increasing our agricultural capital, the wastes are to be cultivated? The whole capital of the kingdom being already vested in commerce, agriculture, or the funds, if wastes are inclosed and improved, the money for that purpose must be drawn from one of the two first sources; for if the improver sells stock out of the funds, another person must buy, and the money with which he buys the stock, must be taken either from agriculture or commerce; if from the former, some lands already in cultivation may be neglected. Mr. R W. would not be understood to think the improvement of wastes injurious to the country, provided they are sufficiently good to pay for it; but says, "do not force any capital from a more profitable employment, to one which is less so."

On the Reproduction of the Buds of Plants, Trees, &c.

The Philosophical Transactions for 1805 contains a curious paper by Mr. *Thomas Andrew Knight*, in which he inquires into the origin of new buds: he remarks, that "every tree in the ordinary course of its growth generates in each season, those buds which expand in the succeeding spring; and the buds thus generated contain, in many instances, the whole of the leaves which appear in the following summer. But if these buds be destroyed during the winter, or early part of the spring, other buds, in many species of trees, are generated, which in every respect perform the office of those which previously existed, except that they never afford fruit or blossoms." If the fruit-stalks of the sea cale *(camle maritima)* be cut off near the ground, in the spring, and the same be left standing during the following summer and winter, the inside of the stalk will decay at the top, and the rain water will collect therein like a cup; yet in the following spring new buds will frequently be seen springing from *the inside* of this cup. Some potatoes were planted late in the spring of 1802 in very dry ground, and vegetated but feebly:

in the succeeding autumn some of these old roots remained sound and entire, and, when the rains fell plentifully, new shoots came up from them: on examining these, the buds and shoots were found to proceed, not from the rind or outside of the potatoe sets, but from the surface made by the knife in dividing the roots into cuttings! These buds sprung from the alburnous substance of the root, and neither from the central part of it, nor from the surface in contact with the bark or rind. A number of seedling plants of the apple, pear, and plum trees, were raised in the spring of 1802, and in the succeeding autumn the earth was removed from around them, so that the plants could be cut off about an inch below the place where the seed-leaves grew. In the following spring the remaining stumps of these plants were examined, and small elevations were in April observed on the bark of them: on removing the bark carefully from several of them, it was found, that they were occasioned by small protuberances on the surfaces of the alburnum, or white wood of the plants: as the spring advanced, the several elevations were evolved into complete buds, and produced shoots similar to those of the organized buds of the preceding year. Similar experiments were made on the roots and trunks of old trees, and by these the buds were reproduced precisely in the same manner as on the annual roots. Mr. *Knight* believes that few, if any seeds, contain less than three buds, one only of which, except in cases of accident, germinates; some seeds appear to contain a much greater number; the seed of the peach seems provided with 10 or 12 leaves, each of which probably covers the rudiment of a bud, and the seeds, like the buds of the horse-chesnut, contain all the leaves, and apparently all the buds of the succeeding year. A turnip of a mixed breed, between the English and Swedish variety, had the greater part of its fruit-stalks cut off, and all its buds destroyed: after remaining thus some weeks, in an apparently dormant state, the first seed in each pod germinated, and bursting the seed-vessel, seemed to execute the office of a bud and leaves to the parent plant, during the short remaining term of its existence, when its preternatural foliage perished with it. Mr. Knight's conclusions seem to be, that the alburnum of perennial plants possesses the power of generating buds, when those in the cortical substance are accidentally destroyed; but that annual and biennial plants appear not to possess this property. This paper will be found at length in the Repertory, No. 44, new series.

Observations.—Several common trees and shrubs, as the aspen *(populus tremula)*, the elm *(ulmus campestris)*, the black thorn *(prunus spinosa)*, and others, annually throw out buds and shoots from almost every part of their roots: the white thorn *(cratægus monogyna)* will produce buds and vigorous shoots, from the exposed part of its roots, when the trunk or stem of the plant is cut away, as before observed, under the head of Inclosures.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

On the Means of measuring the initial Force of Projectiles discharged from Cannon, both in an inclined and horizontal Direction. By M. PRONY.—*Jour. des Mines,* No. 92.

THE physical and mathematical class charged Mess. Bossut, Monge, and Prony, to give in a report respecting the method of measuring the initial velocity of projectiles discharged from fire-arms, proposed by Col. Grobert. The following is a description of the Colonel's apparatus:

A horizontal revolving axis about 34 decimetres (11 feet 1 inch) in length, has at each of its extremities a circular disc of pasteboard: they are perpendicular to the axis, and have each of their centres coinciding with that axis; they are so fastened to it, that the whole may turn rapidly without deranging the positions of the respective parts.

A rotatory motion is given to the two discs by means of a weight suspended at the end of a cord, which, after having passed over a pulley, rolls upon a wheel and axle level with the discs: an endless chain passing round the wheel and the axis of rotation of the discs, transmits to that axis the motion which the weight imparts to the wheel during its descent.

This machine possesses some advantages over one invented by a mechanic named Mathey, and mentioned in Antoni's Essay on Gunpowder; especially in the horizontal position of its axis, which admits the utmost degree both of firmness and uniformity in the position and motion of the disc; in the projectile not traversing a cylindrical surface, but two vertical planes, whose extent and distance may be very considerable, thus furnishing more accurate results; and in the advantage it affords, of measuring the velocity of balls of different calibres, when discharged in oblique directions.

In using this apparatus, all that is requisite is to give a known, uniform, angular velocity to the discs; and to measure the arc intercepted between two planes passing through the axis of the disc, one of them passing through the hole in one disc, the other through one in the opposite disc.

The space descended was measured by the turns and parts of turns of the cord wound off in a given time.

To measure the arc, a pasteboard skreen was fixed before each disc, at a very small distance from it; so that the ball, during its passage, first pierced the first skreen, then the first disc, after-

wards the second skreen, and lastly the second disc. When the piece was discharged, the hole of the first disc was placed opposite to that of the first skreen, and these two holes were in the same straight line with that made in the second skreen; a wire directed horizontally through the centre of the latter hole pierced the second disc; and the arc having its centre in the axis of rotation comprised between the centre of that wire, and the centre of the hole made by the ball in the second disc, gave the measure of the angle described by the system while the ball was running over the length of the axis.

The fixed skreens which give the absolute direction of the path of the ball, afford also, obviously, the means of shewing the defect of parallelism, if there be any between this path and the axis of rotation of the discs.

The gun-barrel was fixed horizontally, parallel to the axis of the discs, and at such a distance from the first disc, that the agitation of the air occasioned by the explosion could not affect that disc.

By a cursory observer it may perhaps be supposed, that the time occupied by the ball in passing from one disc to the other, will be too short to admit of an arc being described susceptible of mensuration; but a statement of the fact will remove the supposed difficulty: when the motion was become uniform, the wheel and axle commonly made .833 of a turn in a second, and every turn of the wheel produced 7.875 turns of the axis of the discs, which consequently made 6.56 turns in a second. Thus a point on the disc, at the distance of a yard from the axis, would move about 42 yards in a second, and in $\frac{1}{100}$ of a second more than 15 inches; a length fully sufficient for accurate measurement.

The experiments were made with an infantry firelock and a horseman's carbine, their lengths in the bore being 3 ft. 8 inch. and 2 ft. 5 inch. The medium weight of the balls was 382 troy grains, and each was impelled by half its weight of powder.

The formula employed for calculating the velocity of the balls was $V=\frac{2\pi n}{kt}\cdot\frac{r}{a}b$, where π=the semiperiphery to the radius unity, k=the ratio between the turns made by the wheel and axle and the arbor of the discs, t=the time in which the wheel and axle made the number of turns n, r=the distance of the hole made by the ball in the second disc from the centre, a=the arc described by this hole while the ball moves from the first to the second disc, b=the distance between the discs, and V=the velocity of the ball.

Ten experiments being made by the carbine, the mean velocity thence deduced was 390.47 metres, or about 1269½ feet per second: the mean velocity for the musket balls was 428 metres, or about 1397 feet.

Reducing the quantities of powder to half the former charges, or $\frac{1}{4}$ the weight of the ball, the mean velocities were 822$\frac{1}{2}$ and 829 feet; each being more than the halves of the velocities communicated by the full charge.

A few experiments, but by no means enow to determine the point with sufficient precision, were made with a view of ascertaining the effect of the air's resistance upon the motion of the ball: when the muzzle of the gun was placed 60 feet farther from the first disc than in the former experiments (in all 67$\frac{3}{4}$ feet), the mean velocity was diminished in the ratio of 42 to 34, or the loss of velocity was about one fifth.

Col. Grobert's apparatus might obviously be enlarged so as to be adapted to experiments with cannon balls. The Colonel likewise proposes the following adaptation of his contrivance to projectiles fired at different elevations: Assign to each of the discs a separate axis, and let the wheel and axle have a wheel at each end, with an endless chain, one turning the arbor of one disc, the other that of the other disc. Thus the rotatory motion imparted by the descending weight is communicated equally to both discs at the same time, the wheels and arbors being made of exactly corresponding dimensions. The supporter of the disc farthest from the gun is moveable vertically, so that it may be raised to the proposed elevation; a few links being added to the endless chain for every increase of height. It must be remarked, however, that the projection of the surface of the discs on the plane perpendicular to the line of firing diminishes in proportion as that line inclines: yet this is but a small inconvenience, as the greatest diminution that can thus be occasioned is in the ratio of about 7 to 5, leaving a sufficient field for pointing with precision.

The Colonel has also applied some additional machinery for the purpose of reckoning the time; but as this is rather complicated, and is not essential to the apparatus which occasioned this paper, it need not be explained here.

It may be apprehended, that the motion of the first disc would cause some deflection of the ball from its true path before it reached the second. To ascertain this, three skreens were fixed at equal distances, the second and third being placed before the first and second discs respectively: now it is manifest, that if any deviation took place, the hole in the third disc would not be in the same vertical plane with those made in the first and second. Experimental proofs, founded upon this consideration, have satisfactorily evinced that no such deviation takes place: and indeed that there cannot, in fact, be any sensible deviation, will be evident on recollecting the extremely short interval of time employed by the ball in passing through the disc; a sufficient interval is not allowed for the cohesive forces of the particles of the disc to be brought into efficient exercise.

Observations.—In this paper there is likewise exhibited a very concise view of the experiments and observations of *Robins*, *D'Arcy*, *Hutton*, Count *Rumford*, and *D'Antoni*: but there is no mention of some of the valuable suggestions of *Euler* in his translation of Robins's Gunnery. On comparing Colonel Grobert's method with the method so successfully pursued by Mr. Robins and Dr. Hutton with the ballistic pendulum, it would seem, that in Grobert's method simplicity and economy are very ingeniously united, and the results are obtained by the application of a simple and obvious theorem; while in Robins's method it is necessary to solve a complex dynamical problem, in which it is difficult to assign some of the data with sufficient precision. Notwithstanding this, however, the contrivances suggested by Robins have considerably the advantage over those of Grobert in point of extensiveness and generality in their application.

From some of the later experiments of Dr. Hutton it has been determined, that the velocity of the ball varies as the square root of the charge directly, and as the square root of the weight of ball reciprocally; but this law does not appear to have been followed in the results of the French experiments; for, agreeably to this law, the velocities with the half-charges ought to have been 897 and 988 feet, instead of 822½ and 829 feet. Laying great stress, as *we* do, upon the considerable variety, extent, and long time devoted to the experiments carried on by Dr. Hutton, we cannot help suspecting the accuracy of the conclusions deduced from Grobert's method, and cannot, therefore, recommend it very warmly, though we readily admit its ingenuity.

Report made to the physical and mathematical Class of the National Institute, relative to M. Six's Proposal concerning Fire Engines. By Mess. CHAPTAL *and* MONGE.—*Ann. de Chim.* No. 161.

M. *R. Six*, the chief engineer of the fire-pumps of the city of Paris, has proposed to substitute for the common water used in extinguishing fires, water saturated with sea salt *(muriate of soda)*.

The advantages proposed are, 1. The presenting a liquid which will never freeze in any temperature of our climate. 2. The employing a liquor more proper than pure water to put out fires. 3. To preserve the vessels for a longer time; the water freezing within them frequently occasioning a rupture. 4. To guarantee the water from all decomposition. 5. To preserve the containing vessels from so speedy a destruction as that which is experienced with fresh and stagnant water.

Messrs. *Chaptal* and *Monge*, who were directed by the Institute to consider this proposal, founded their opinion upon an examination of the two following questions: 1. At what degree of cold, water freezes when charged with sea salt to divers degrees of saturation? 2. Whether water saturated with sea salt would not attack and destroy the leather pipes employed at fires?

To answer the first question, they subjected to all the degrees of cold most likely to occur in these climates, as produced by a mixture of pounded ice and powdered sea salt, medicine-phials filled with a solution of sea salt at several degrees of saturation, from 2 degrees up to 20. The experiments sufficiently established this point, by shewing, that in solutions of 19 or 20 degrees nothing more was formed than some slight crystals on the sides of the phial.

In answering the second question, whether the use of this salted water would not impair the leather of the pipes of the pumps? these gentlemen had it in their power to consult both experience and observation. M. Bonjour, Director of the National Salt-works, apprised them, that in those of Meurthe they have long had in use for elevating the water, pumps in the cylinders of which the valves are shielded with leather; and that notwithstanding the uninterrupted service of these pumps, and the contact of water charged to 16 degrees of saturation, they have observed neither alteration nor deficiency that could be imputed to the action of this liquid.

But even if it were true, that the solution of salt corroded the leather, or rendered it more brittle, these gentlemen would not then proscribe its use; for the engineer of these fire-pumps observes with reason, that in the state of actual service they carefully wash the pumps and their pipes immediately after they have been used, to cleanse and take away all the impurities that had been deposited by the foul water which may have been employed; so that the employment of the salt water occasions no new care on the part of the firemen; and it is therefore concluded, that M. Six's proposition merits the approbation of the Institute.

Observations.—It cannot fail to strike the attentive reader, that the philosophers employed by the Institute confined their examination to too few points, and particularly that they have adopted no measures to shew, that the second and fifth of the assigned advantages arising from the use of sea salt will really be found to take place.

Impressed, however, with the importance of giving publicity to any method which is at all likely to be of utility in the extinction of fires, we have inserted the preceding; and shall take this opportunity of mentioning a few other contrivances having the same object in view. See also our first Number for Mr. Tilloch's ingenious speculations on extinguishing fires in ships.

About the year 1720 a Mr. *Zachary Greyl* devised a fire-extinguisher, which consisted of vessels of wood, and contained only water; they were exhibited before several of the nobility, but did not meet with encouragement. A minute account of them was given in a German treatise, entitled, *Misolungene Versuche mit der Greylischen Maschine, von Thummig*, published in 1721. Some years after, *D'Ambrose Godfrey* produced certain vessels, which were said to succeed in every respect: these are described in a French pamphlet, viz. *Lettre de Londre, du 5 Juin* 1761, *par M. Deschamps, sur une Expérience publique touchant la nouvelle Manière d'éteindre le Feu, inventée par M. Godfrey, faite par la Société formée pour l'Encouragement des Manufactures et du Commerce en Angleterre*, and are probably described in some of the earlier volumes of the Transactions of the Society of Arts, &c. They are supposed to have been an improvement on Mr. Greyl's, were constructed with wood, and filled with a chemical liquor, consisting of water, oil of vitriol, and sal ammoniác. When thrown into rooms and other places that were purposely set on fire, they burst, and by their explosion are said to have completely extinguished the flames; but they were useless after the roof of a building had fallen in.

In the year 1794 a Swede, named *Van Aken*, shewed publicly at Stockholm, Copenhagen, Berlin, &c. that he could very expeditiously extinguish fires by a *small* quantity of a liquor denominated anti-incendiary; which consists of 40 parts of sulphate of iron, and 30 parts of sulphate of alumine, mixed with 20 parts of red oxyd of iron *(calcothar)*, and 200 parts of clay. The particulars of M. Van Aken's mixture and its success being communicated to M. Van Marum by the celebrated Klaproth, he commenced a series of comparative experiments, by setting fire to two combustibles, equal in every respect, and by extinguishing one of them with Van Aken's liquid, and the other with common water. He was not a little surprised to discover, that by using the two liquids in the same manner, the fire was always more expeditiously extinguished by water than by the anti-incendiary liquor; but he observed, at the same time, that *a very small quantity of water, when properly directed, extinguished an extremely violent conflagration.*

That a small quantity of water may extinguish a violent fire, will easily be conceived upon reflecting, that the flame of any burning substance must cease, as soon as any cause prevents the atmospheric air from touching its surface: thus, when a small quantity of water is thrown upon a body in a state of violent conflagration, this water is at first reduced partly to vapour, which, rising from the surface of the burning substance, repels the atmospheric air, and consequently represses the flame, which, therefore, cannot appear whilst the production of the vapour continues; but a full current of water moving with ra-

pidity in the usual way as discharged from an engine, in consequence of the lateral communication of motion in fluids, will carry with it a current of atmospheric air (as in the water-blowing machine), and thus in some measure feed and augment the fire.

In the application of Van Marum's method of extinguishing fire, even to put out the most violent flame it is necessary only to wet the surface of the burning substance where the flame appears, and for this purpose only a small quantity of water is required, if it be applied judiciously to the burning part. Thus the point to be attended to in extinguishing a fire is to direct the water so that the whole surface of the burning part may be wetted and extinguished, and that in such a manner that no extinguished spot may be left between two others that are on fire: for, if attention be not paid to this particular, the heat of the flame burning here and there, rapidly converts into vapour the water with which the extinguished wood has been wetted, and it again takes fire.

Van Marum's method has been tried with complete success at Haarlem, Gotha, and various other places on the continent; and a minute account of some of his experiments was given nearly four years ago in the *Annales de Chimie*.—See Repertory of Arts, &c. vol. iii. p. 461, new series.

Considerations on Colours, and several of their singular Appearances. By C. A. Prieur.—*Ann. de Chim.* No. 160.

The object of the author of this memoir is to give a general theory, by the help of which all the cases of coloured appearances may be referred to certain principles. He sets out from the known opinions with respect to the different kinds of luminous rays, the colours resulting from a mixture of several of them taken at different parts of the solar spectrum, and among others, the very remarkable case where the rays are so chosen that their union produces the sensation of whiteness, even though two sorts of rays only be employed: for these ideas we are indebted to the immortal Newton.

If we are desirous of fully comprehending what takes place in the vision of colours, it is indispensable in the first place, that we should have a familiar acquaintance with the shades composed of several simple rays; that we acquire precise ideas of *black* and of *white*, and of the complication they introduce into coloured appearances; and especially, that we make ourselves acquainted with the relation of colours, which taken two and two in a certain order, are, by their union, capable of forming white, or any other complex tint, at pleasure. Two colours having this relation to each other are reciprocally termed *complementary colours*; and

one of these being given, the other may be determined with greater or less precision by various methods.

This author employs, also, the word *contrasts*, to characterize the effect of the simultaneous vision of two substances of different colours, when brought near together under certain circumstances. So that *contrast* is here a comparison from which results the sensation of a certain difference, great or small. The contrasts of simple colours have not yet been thoroughly examined. As to compound colours, the effects of contrast are produced by abstracting from a colour the rays analogous to that contrasted with it. Thus if we place on red paper a slip painted orange colour, the latter will appear nearly yellow: while orange on yellow appears red,—on violet, yellowish,—and on green, a different red. This is explained by supposing orange to be compounded of all the rays except blue.

Contrasts are varied by circumstances, as by the degree of light, slight fatigue of the eye, &c. But an excessive fatigue of that organ produces a degeneration of colours belonging to another mode. We ought not, therefore, to refer to contrast those impressions mentioned by Æpinus, which are propagated in the eye with a certain duration, and a particular period of tints, when one has looked intensely at a brilliant light, such as the sun. But the colours termed by Buffon *accidental*, belong to the class of contrasts, or at least follow the same law. And the *coloured shadows* of which Count Rumford treats in his Essays, are phenomena of the same kind. To the effects of contrast also M. Prieur ascribes the appearances of the solar light received through a hole in a coloured curtain; the various cases of colours displayed by opals; the grayish dust collected by age on papers; and the blueness of the veins.

He proposes a method of making contrasts very sensible, the observer being in a room with a good light, which consists in placing against the window the coloured papers on which he means to observe the contrasts; the coloured paper serving as the ground will then possess a degree of semi-transparency, while the little slip of a different colour placed over it, is, on account of the double thickness, more opake, and in the shade: thus the colour produced by the contrast is rendered far more striking. It is this arrangement which produces the singularly striking effect of the contrast of a little slip of white card applied successively on paper, glass, or stuff, of any colour whatever. When the transparent body is red, the opake white appears of a blueish green; if the ground be orange, it is then decidedly blue; on a yellow ground, a kind of violet; on a crimson ground, green, &c.; always corresponding exactly to the *complementary colour*.

To obtain the full effect in repeating these experiments, reflected light and double fringes must be guarded against. We always have it in our power to remove this inconvenience by con-

cealing the troublesome objects by a piece of black pasteboard or stuff, or by looking through a blackened tube which confines the field of sight to the necessary extent.

The knowledge of contrasts may be advantageously applied to those arts which have a relation to colours. The painter knows that it is not a matter of indifference what colour is placed near another: but when he is acquainted with the law to which their actions on each other are subjected, he will be better able to determine what to avoid and how to dispose his tints, so as to heighten the brilliancy of that which he wishes to bring forward. Contrasting them in succession likewise affords valuable indications of their nature and composition. This the author himself put in practice with success in his manufactory of colours and paper-hangings.

These considerations relative to contrasts led him to examine a very singular case proposed and treated of by Monge, namely, the white appearance under which a coloured body is sometimes seen when viewed through a piece of glass of the same colour. Our author's conclusion is, that in such cases when we have the perception of whiteness, it is solely owing to the action of contrasts, by which the impression of the colour is deadened or annulled; while that of a certain degree of brightness still subsists, and is noticed from the opposition of a greater degree of obscurity. This way of viewing the subject, leads to a new definition of whiteness, which certainly has nothing in it inconsistent: *white is with respect to us the sensation of light, when no particular colour predominates or is perceived.*

His method of making his experiments is simple. If the substance be opake, he places it on a piece of black cloth, in order to observe it with the prism. If it cannot be cut so as to reduce it to a rectangular figure, he covers it with a piece of blackened pasteboard, pierced with a rectangular aperture. Then, the coloured fringes displayed on the two opposite edges indicate the kind of rays reflected, and consequently those absorbed when we know the nature of the illuminating pencil; and as the fringes themselves are of complex tints, the simple ones which compose them must be discriminated. A plate or table may be constructed after Newton's method, and used for determining the tints composed of several elementary colours. If the body to be examined be transparent, it will be proper to view it through the aperture of the card before spoken of, in order so to exclude extraneous light that the prism may shew the fringes.

This author has found that many opake bodies are indebted for their colours to the following conditions: 1. Each of the bodies always absorbed the rays that were complementary to the predominant colour. 2. In some, the absorption included, besides the complementary kind, others collateral to it, and more or less numerous. 3. The darker a colour is, the fewer kinds of rays it reflects. Here the author does not speak of colours arising from

mechanical mixture, but only those which form a homogeneal compound, or a true *combination* in the sense of the chemists.

Transparent bodies, such as coloured glass, and liquors contained in a bottle with two broad parallel sides, followed indubitably the same law. In all, the absorption commences w th the rays most opposite to the predominant colour of the illumined body. It goes on to those which come next in the spectrum; and thus proceeds regularly, and not *per saltum* to the last kind: so that the body grows darker and darker, and terminates by becoming black.

The author dedicates a concluding paragraph to the examination of a variety of phenomena: such as the colour of bodies at different degrees of incandescence; the appearances of lamps seen through a mist, and of the sun through a smoked glass; and he asserts, that the colours of metallic oxydes are proportionate to the oxygen.

Here too he descants upon the properties of coloured clouds, especially those we see about the rising and the setting sun. This phenomenon, which had hitherto been without a satisfactory explanation, our author ascribes not to *refraction*, but to the *absorption* of the solar rays. Commonly the first rays attacked by the aerial vapours are the blue approaching to violet. Soon after they absorb the contiguous rays, gaining with more rapidity the blues properly so called, then the greens and yellows, proceeding thence to the reds: hence the yellowish, orange, and red colours, under which the clouds appear. This period of tints, namely the evening, manifests itself gradually as the sun approaches the horizon. Terrestrial objects, the part of the air near the sun's disc, and even that disc itself, are successively tinged with the same hues. Accordingly, when the solar rays are received on a prism, it is seen that the rays really absorbed correspond to the general coloration of the moment.

From the successive increase of the vapours traversed by the light in thickness and density, it follows likewise, that clouds differently placed must at the same instant be clothed in different hues. The highest may be white, while others at a less elevation will be yellow, and others still lower will be proportionably redder. At equal elevations, the most distant from the point where the sun sets will incline to red, and the nearest it to yellow. Blue or green shadows may then be seen on bodies naturally white, as Buffon and others have observed. These are nothing more than the effect of contrast between the actual colour of the enlightened and of the obscure part.

Contrasts may also render the colour of the clouds complex, as, for example, when a great portion of the sky appears *blue*. There are some clouds the colour of which arises solely from this cause; and such may be seen at times in the middle of the day, when we have a lofty mountain behind us, or are in any other situation

where the eye is defended from the too powerful action of either the direct or reflected solar light: in this case the clouds have a yellowish tinge, being the complementary colour to sky-blue.

Sometimes we see the moon of a similar colour, when she is very high, a little before or after the sun has passed the horizon. Moreover, she appears thus, or even altogether white, when clouds variously coloured by the vapours of sunset or sunrise exist at the same time in the atmosphere. From this concurrence of circumstances we have a new proof of the difference of causes to which these colorations are owing.

Finally, it may be remarked, that from the irregularity of the earth's surface, and of the state of the atmosphere, these phenomena are liable to be concealed, or subjected to various interruptions. In our climate the colouring of the clouds seldom attains its last stage. On some evenings, however, when the sky is very clear towards the part where the sun sets, light clouds at the same time floating high over our heads, they will be seen at a subsequent period clothed with a brilliant red, heightened by the diminution of light on the earth, obscured soon after, and at length becoming extinguished in shade.

Observations.—Notwithstanding the ingenuity of the experiments and explanations in this paper, its author seems very far from having sketched a complete theory of colours. A subject so extensive and so complex, requires much more to be done; and when any philosopher of a profound mind, at once happy in the suggestion of experiments, judicious in the management of them, and cautiously accurate in making deductions from them, shall take up the subject, this paper of M. Prieur's may furnish him with some useful hints.

We shall close with a remark due to the liberality of this author, and indeed, of nearly all the continental philosophers who treat of the subject of light and colours: he is anxious to appreciate and to acknowledge "what we owe to the genius of the *great Newton*, who opened this career in such an admirable manner;" while some of the countrymen of that illustrious philosopher, whose names ought not to stand on the same page with his, pert and petulant upstarts who are scarcely able to *read* the performances of Newton, make no other use of the little knowledge they so acquire than that of sneering at his labours, ridiculing his "superstitious veneration for the number seven," and thus striving to diminish the authority of him on whose shoulders they now stand to gaze superficially into the works of nature: that weak heads should turn giddy when a little elevated, is not to be wondered at; but we think it would be decent not to cavil at him by whose means they have thus

"Grown ten times wiser than before,"

On the Thermometers of baked Earths termed Pyrometers. By M. FOURMY.—*Journ. des Mines.*

THIS paper communicates the results of an extensive series of experiments with a view to determine how far Wedgwood's pyrometer is to be depended upon in practice. The detail of these experiments would occupy too much room for this work; the conclusions, however, are as follows: M. Fourmy shews that the effect of shrinking, upon which Wedgwood's pyrometer is founded, does not result solely and invariably from the cause to which it is ascribed,—that it is not necessarily proportionate to it,—that, whatever may be the gradation and the continuity of temperature applied to an aluminous mixt, its shrinking is not only not necessarily graduated, or necessarily continuous, but it also does not always necessarily take place; and therefore that a pyrometer founded upon such shrinking, does not afford so constant and accurate a measure for the higher degrees of heat, as the dilatation of mercury or of alcohol does for the lower.

Observations.—About four years ago M. *Guyton* exhibited to the French National Institute an instrument for measuring the highest degree of heat produced in furnaces. It consists of a rod or bar of platina, placed edgewise in a groove, made in a bed of refractory clay: one end of this bar rests upon the brick-work that surrounds the groove; the other end bears upon a lever with two arms, the largest of which forms an index or needle upon an arch of a graduated circle; so that the motion of this index shews the increase in length of the bar of metal occasioned by the heat. The bed of clay having been burned in heat of the most intense degree, no apprehension need, in M. Guyton's opinion, be entertained of its shrinking; and the dilatation it might experience during the time of incandescence, would affect only the very small distance of the needle's centre of motion from the point of contact with the bars, that is, so as to diminish the effect rather than augment it. The whole of this instrument being of platina, it is liable neither to fusion nor oxydation.

M. Guyton commenced a series of experiments to examine the accuracy of this pyrometer, to compare it with Wedgwood's, and thus to determine what degree of reliance may be placed on either of these instruments. As soon as we have learned the results of these comparative experiments they shall be communicated to our readers.

Thermometers for registering the highest and lowest Temperatures, in the Absence of the Observer. By F. A.—*Phil. Jour. No.* 47.

The contrivance here described consists simply in two thermometers, one mercurial and the other of alcohol, having their stems horizontal: the former has for its index a small bit of magnetical steel-wire, and the latter a minute thread of glass, having its two ends formed into small knobs by fusion in the flame of a candle. The magnetical bit of wire lies in the vacant space of the mercurial thermometer, and is pushed forward by the mercury whenever the temperature rises, and pushes that fluid against it: but when the temperature falls and the fluid retires, this index is left behind, and consequently shews the maximum. The other index, or bit of glass, lies in the tube of the spirit thermometer immersed in the alcohol; and when the spirit retires by depression of temperature, the index is carried along with it in apparent contact with its interior surface: but on increase of temperature, the spirit goes forward and leaves the index, which therefore shews the minimum of temperature since it was set. As these indexes merely lie in the tubes, their resistance to motion is altogether inconsiderable. The steel index is brought to the mercury by applying a magnet on the outside of the tube, and the other is duly placed at the end of the column of alcohol by inclining the whole instrument.

Observations.—Such is the common contrivance for a self-registering thermometer, now exhibited for sale in the London shops. Its explanation depends upon the obvious circumstance, that, if the small glass piece were protruded beyond the spirit, the fluid would hang to it and draw it back. Besides this, the principal self-registering thermometers are those of Six, Rutherford, and Keith. The last of the thermometers invented by Mr. Keith has clock-work so adapted to it, that it registers with tolerable precision not merely the extremes, but the degrees of heat and cold for every month, day, and minute in the year. This invention is too complex to be described here: those who wish to know more of its construction, may consult the fourth volume of the Transactions of the Royal Society of Edinburgh, or the third volume of the quarto series of Nicholson's Journal.

An Apparatus for raising Water by means of Air condensed in its Descent through an inverted Syphon. By Mr. Wm. Close. —*Phil. Jour.* No. 45.

This gentleman has from time to time published in Nicholson's Philosophical Journal, several modifications of an hydraulic engine

for *raising* water, operating upon the principle of the syphon. The inverted syphon, when applied to raise water in the manner described in this paper, has its higher orifice placed in a situation to receive both air and water at the same time. The air being conveyed by the velocity of the aqueous column to the lowest part of the syphon, and collected in a vessel, is employed as the medium for conveying pressure to raise water in another part of the apparatus.

Observations.—It will be needless to attempt a minute description of this apparatus without copying the engraving which accompanies the original paper; and this seems hardly necessary, as the effect produced by this engine is inferior to some of a well-known and simple construction. According to the statement of Mr. Close, if the apparatus be so adapted to the supply, as that 28 or 30 gallons from the cistern will raise one gallon 18 feet, so 84 or 90 gallons will raise one gallon 44 feet, by three ascending columns; while Mr. Sarjeant's bucket engine at Irton Hall, in Cumberland (described in the *Transactions of the Society of Arts, Repertory of Arts,* and *Nicholson's Journal),* raises one gallon of water 60 feet high by a supply of 36 gallons. So that Close's engine will not perform more than half the work of Sarjeant's; and its peculiar advantages, as its inventor admits, must depend upon its durability when constantly employed.

Observations and Experiments on the conducting Power of Fluids. By T. S. Traill, M. D.—*Phil. Jour.* No. 46.

Count Rumford was the first who maintained that fluids are absolute non-conductors of caloric; a conclusion which he drew from the interesting fact he discovered, of the extreme slowness with which ice melted when a stratum of cold water was interposed between it and the heated body. Dr. Traill in this paper controverts the Count's opinion. After speaking of the experiments of Dalton, Thomson, Nicholson, and Murray, he adduces other proofs of the conducting power of liquids in several well-known facts. 1. They assume a common temperature in mixing. 2. Especially, when mercury and water at different temperatures are mixed, an interchange of caloric takes place. 3. Rumford's beautiful experiment, in which water in a glass tube was made to boil over a cake of ice, by the application of a heated body to the upper part of the containing tube, without affecting the ice, for a long time, sufficiently proves the slowness with which glass transmits caloric, and clearly indicates that the sides of the vessel in several of the experiments of the above-mentioned philosophers, could not be the sole conducting medium. 4. The sixteenth experiment in Rumford's seventh Essay, affords another argument

against his opinion: for it shews that hot water poured on cold does not raise its temperature by currents. 5. If liquids were absolute non-conductors of heat, it would necessarily follow, that when caloric was applied to the upper surface of different liquids, other circumstances remaining unchanged, and provided the liquid did not increase in specific gravity by cooling, *equal increments of temperature would take place in equal times.*

Dr. Traill, with a view to ascertain this point, devised the following apparatus for the purpose of transmitting heat downwards. A cylindrical vessel was turned, out of wood, having its sides half an inch thick, its height four inches, and its diameter two. It has a moveable wooden cover perforated with a hole in its centre rather more than an inch in diameter, into which an iron cylinder of an inch diameter could be easily introduced. This cylinder is supported by a slight shoulder-piece, and can be raised by a string attached to its top. When the iron bar is in its place, its flat lower extremity is half an inch distant from the bulb of a delicate mercurial thermometer, which is fixed with wax, in a hole perforating the cylinder near its bottom: this thermometer has a capillary tube, and is bent to a right angle, so that its bulb and part of its stem lie in the axis of the wooden cylinder. By means of this apparatus, a cylinder of metal at 212° of Fahrenheit was put into various liquids in succession, the liquids being all at 67°, and the time the thermometer took to rise through three degrees, viz. to 70°, was accurately marked by means of a stop-watch: these times varied much:—mercury required 15 seconds; water, 7′ 5″; proof spirit, 8′ nearly; alcohol (London Pharm.), 10′ 45″; &c. &c. The temperature was always too high to produce a descending current in water by heating. Dr. Traill naturally concludes, that if we find the thermometer requiring different times for its elevation through equal intervals, as in his experiments, we must ascribe it to the *conducting* powers of the medium between it and the heated body: hence fluids are proper conductors of heat.

The Count's facts, this writer observes, may be as well explained by the slow conducting energy of fluids, as by their being non-conductors; and the circumstance of very slow currents will explain the appearance observed on the Glaciere of Chamouni, which Rumford proposes as a test of his opinions, full as satisfactorily as those opinions themselves.

Account of submarine Mines in Cornwall.—*By Mr.* HAWKINS. —*Rep. of Arts,* No. 40, New Series.

THIS paper was published with a view of convincing those who have any doubts respecting the practicability and safety of the proposed passage beneath the Thames from the London Docks to

Redriffe, that works of a similar nature, attended with far greater difficulties, have been successfully executed.

The mine of Huel-Cok, in the parish of St. Just, in Cornwall, which descends eighty fathoms, extends itself forward under the bed of the sea beyond low-water mark. In some places the miners have only three fathoms of rock between them and the sea, so that they very distinctly hear the movement and the noise of the waves; the rolling of the stones and rocks over head, which the sea moves along its bed, is also plainly heard: this noise, mingled with the roaring of the waves, sounds like reiterated claps of thunder, and causes both admiration and terror to those who have the curiosity to go down.

In one place where the vein was very rich, the miners searched it imprudently, leaving but *four feet* of rock between the excavation and the bed of the sea. Here, at high-water, the howling of the waves is sometimes so dreadful, that the miners working near often take themselves to flight, apprehending the breaking in of the sea through so weak a roof.

In some places of this mine, under the bed of the sea, where there is only a small wall of rock between the mine and the sea, nay, in one place not more than four feet, yet only a small quantity of water enters the mine by leakage: when the miners perceive any chinks which might admit it, they stop them up with clay, or with oakum.

A more enterprising work even than this was executed in the midst of the sea itself, near Penzance. The place where the tin ore is found is in the sea, about 200 yards from the shore; and as the bank of the sea is here very steep and high, this distance is no less at low-water. At high-water this place is covered by the water six yards deep; and as the bottom is gravelly and rocky, the waves are greatly agitated and rise very high, when the wind blows from certain points. This inconvenience takes place all the winter; and though the rock rises a little above the surface of the sea at low-water, yet there are not ten months in any year in which it was uncovered.

These difficulties were encountered by one whose whole property was not worth fifty crowns. This courageous miner employed three summers in sinking a pit, during which he could only work two hours a day, and *always* when he went to work found his excavation *full of water*. He was obliged to empty this before he could touch the work, and it occasioned still greater difficulties when he set about blasting it. At first he needed only strength and patience; but as he sunk to a greater depth, he united to them ingenuity. He built round the mouth of his pit a turret of wood impervious to water, and was thus enabled to prolong the time of working on the rock. He next endeavoured to raise the turret above the greatest height to which the sea could reach: but here he had new difficulties to conquer, viz. to make this turret

water-tight, and so firm and strong, that it should not be overturned by the shocks of wind and waves. Luckily the rock was a porphyry, not too hard to cut, but still very firm: he shaped the portions he separated from it, disposed them regularly at the bottom of the turret, and closed and caulked with oakum and fat cement, all the interstices between the wood and the stone, so that the whole was united into one mass. Like all the Cornish pits, this was lined with planks; and all the joints were well caulked and payed with pitch. Having raised his frame-work, he supported it with iron braces; and formed about the mouth of the pit, so raised, a platform of planks which rested on four great piles, and fixed to it a windlass, worked by four men.

This work took much time, and met with many mishaps in the execution; but the perseverance and presence of mind of the undertaker conquered all obstacles. When the pit and tower were finished, he reaped the fruit of his industry, and established a regular work at *Stockwork*, drew from it in a little time a considerable quantity of tin, and put his adventure on a very good footing.

Subsequent particulars and occurrences relative to this undertaking are likewise described in that number of the Repertory of Arts, &c. whence this account was extracted.

Some Account of the Archway, or Tunnel, intended to be made under the River Thames. By A PROPRIETOR.—*Rep. of Arts*, No. 41, New Series.

A NUMBER of gentlemen have obtained an Act of Parliament for powers to make, underneath the Thames, a communication by means of an archway for foot passengers, and a larger for carriages: they propose to enter upon the smallest first.

The site chosen for the opening of the foot passage is a little to the west of the London Docks, on the north side, and in a line opposite thereto on the Redriffe side. The carriage-road is intended to be opened at or about the ancient horse-ferry at Limehouse and Redriffe. The length of the former of these tunnels will be about 1300 feet, the latter about 1500 feet.

These roads will be not less admirable for the conveniences they will produce, than for the singularity, novelty, and boldness of the undertaking. With respect to their *safety*, however, under the management of skilful engineers, there can be little doubt, when the difficulties which may naturally be expected to attend them, are compared with those inseparable from the management of submarine mines, such as those spoken of in the preceding article.

Account of the double Boats built by the Direction of Sir SYDNEY SMITH, *of building Vessels of this Kind on a large Scale, and of other Vessels formerly built on the same Plan. By Mr.* J. W. BOSWELL.—*Rep. of Arts,* No. 41, New Series.

As these boats have excited much curiosity, a brief account of them may not be unacceptable.

The first double boat built by Sir *Sydney Smith* consists of two of the common Thames-wherries, united by a stage or platform laid over them, of about 20 feet breadth. The wherries were raised one streak to receive this stage, which is formed by pieces of scantling, about 6 inches by 3, laid across the boats, and firmly secured to them, upon which a deck is afterwards laid down. Beyond this stage the boats project about five feet at either end; these parts being also decked over, and the whole water-tight above. Long, narrow hatchways open into each wherry: their heads and sterns are connected by cross pieces, and each is furnished with two masts; so that the double boats carry four masts in all, on which sprit-sails are used, for more conveniently reversing the direction of the vessel without putting about, either end being so formed as to go foremost with equal facility.

Two other vessels have since been built on this plan, upon a larger scale: they are called the Gemini and the Cancer. The stages or platforms of these boats are not so broad in proportion as that of the first. The Gemini has also her two supporting boats formed with the internal side of each, perpendicular and straight, so that each resembles half of a boat, divided lengthwise vertically. The shear of the latter boats is also much greater than than of the first, their extremities being considerably higher than their decks. The Gemini has four masts; the Cancer is said to have but two. Each double boat is furnished with a small gun, placed on the middle of the platform, and is fitted with a suitable number of oars, to be used in calm weather.

The chief advantages of double-hulled vessels are stated to be, —the great velocity with which they may be made to sail,—their considerable resistance to the making of lee-way,—the facility of manœuvring,—their great steadiness, by reason of which they can, if used in war, direct their guns with more effect than other vessels of equal burden,—their taking the ground well, and being steady and secure where other vessels would be overset,—and the great relative size of their decks, which gives more room for working guns, and managing the sails.

Mr. *Boswell,* the ingenious author of this paper, has added historical and practical remarks on this kind of vessels. He justly

observes, that such vessels of a large size should not depend on a single series of beams, but at least two series, one over the other, with an intermediate space of not less than five feet: the lower series of beams should be planked outside, the same as the rest of the vessel, which thus forming the bottom of a third vessel in the midst of the other two, should slope gradually upwards at either end, that it might make less resistance to the waves, and tend to surmount them when it encounters them. This middle vessel, instead of being entirely sustained by the other two, might be so constructed as to draw a foot or two of water; a construction from which several advantages would result.

Double vessels of a large size should not be made to go with either end foremost; for, besides the impossibility of staying their masts properly for this purpose, they could not thus be shaped to the greatest advantage for swift sailing; for the head requiring a certain fulness to bear up against the impulse of the sails, and the stern a certain length of slope, the head also requiring the rounding off to be sidewise, and the stern requiring the sloping to be mostly from the bottom upwards, the shape which would suit the one would not the other, and an intermediate shape would be imperfect for both.

Small double vessels may have the platform strengthened by two or more pairs of shears erected across it, each well secured to the deck by a perpendicular shroud descending to it from the upper angle, or by a mast rising in that part, well bolted to the platform below, and firmly fastened to the shears above: probably the shears in the first of Sir Sydney's boats might have been for this purpose.

Account of a Forge Hammer, with great Power for working Metals, to be worked by one or more Men occasionally. Invented by Mr. GEO. WALBY.—*Trans. Soc. of Arts*, vol. xxii.

THE silver medal and forty guineas were voted by this highly respectable and useful Society to Mr. *Walby*, for his new-invented hammer, for the purpose of forging bricklayer's trowels, rounding of ship's bolts, beating gold or tin foil, planishing brass, copper, &c. or for any other work in which a large hammer may be required upon a simple principle. The weight of this hammer is 70lbs. which, the author says, may be worked by one man, with the speed of 300 blows per minute, with the greatest accuracy and ease, and perform the work of two or three men. The steel is kept in better temper, as it requires fewer heats in doing the same work than is required in the common way. Trowels made, says Mr. Walby, with this hammer, will bear any bending pressure, and return by their elasticity to their original shape; and

they will even cut a chip from a bar of solid iron, without hurting their edge.

Observations.—It is impossible to give a complete and perspicuous description of this forge hammer without referring to a plate; but this we decline in the present case, not because Mr. Walby's invention is deficient in point of ingenuity, but because we can say nothing in favour of its simplicity; being really apprehensive it is too complex to be of any material utility.

Of the Panemore, a Machine moved by the Wind.—Jour. de Phys.

This machine is the invention of M. *Desquinemare*, the author of a composition for rendering linen, and other stuffs, impermeable to air and water. The name is derived from three Greek words, *Pan anemos oro (omni vento afflari)*, denoting its peculiar quality of being moved by every wind. This contrivance is a kind of globe placed on the top of a mast, on which it always turns round with the wind. In consequence of the ingenious adjustment of the curves which this machine presents in all its points, the rotary motion is always in the same direction, be that of the winds as it may; their utmost violence, instead of being detrimental to its action, only augments its power. Its means increase in a cubic ratio when the wind doubles its velocity; and by doubling the surface its power is increased eightfold. By this new method the inventor raises water from a well 20 yards deep, in the court of the water-proof cloth manufactory at Paris. He has likewise applied it to the bruising of grains as food for animals, and intends employing it to grind oil, to make oil, and for the use of light-houses, the effect of which will be greatly increased by the rotary motion of the lights. He considers it as a powerful assistant in the navigation of rivers; and, in general, it may form an economical substitute for the labour of animals and men in all such machinery as does not require periodical attendance. The inventor farther presumes, that it will serve for an accurate anemometer.

Description of Mr. Samuel Clegg's portable Steam Engine. By Mr. J. Dalton.—*Phil. Jour.* No. 47.

This engine is worked by four copper valves in the usual manner, but the mechanism for lifting them is different from any hitherto made: there are no levers employed for opening the

valves, not any hand gear. The steam and exhaustion valves are on the same horizontal plane; those which are vertical to each other are not both exposed to the steam, or both to a vacuum; but by a simple contrivance in the construction of the nozzles, the one is exposed to the steam while the other has a communication with the condensing vessel. Hence, when the two valves are connected together by a straight rod, and this rod is lifted, the pressure is given to the piston, and the machine is put into motion; and if the other two valves be connected in the same manner, and lifted at an appointed time, the engine will be kept in motion: the rods which come out of the bottom of the nozzles are kept tight by vertical stuffing boxes. One of the corner columns which supports the frame serves likewise for an eduction pipe and condensing vessel; and, though the piston-rod works out at the bottom of the cylinder, it is as easily kept tight as if it worked out at the top.

The next is a new contrivance for producing a rotative motion from a reciprocating one, which not only simplifies the machine very much, but exceeds the power of the common crank by one third, in consequence of its always acting perpendicular to the radius of the wheel, which is done by a vertical double rack and wheel. The two vertical parts of this rack are joined by a semicircle at the top, and the whole teethed on the inside, so that the teeth of the vertical wheel are constantly in contact with some of the teeth of the fork formed by the two vertical bars, and the semicircle consisting of the double rack. The wheel and rack are constantly kept in gear by means of a small roller, a sliding bar, and a plate serving instead of a groove to keep the roller from deviation.

Observations.—This contrivance for converting the reciprocating into the rotatory motion, is certainly an improvement upon the very old contrivance, in which a toothed wheel having only half its periphery furnished with teeth, is placed between two parallel bars, whose teeth in the sides front each other: it is also superior to any of Lander's piston-rods, which are but slight deviations from the old contrivance: still we are apprehensive it is not entirely free from practical objections. As far as we can judge from Mr. Dalton's figure and description (neither of which are very perspicuous), although the change from the upward to the downward motion of the piston-rod will be gradual, the change from the downward to the upward motion must be instantaneous, or at least the piston-rod must be brought to rest at once, from a uniform motion downward, and then receive instantaneously a finite velocity in the opposite direction. If this be the case, we venture to assert, that whenever this machine is attempted to be put to

actual work, it will go by jolts, endangering the structure, and this new contrivance will either be modified or abandoned in a few days. All changes of motion must be gradual, in conformity with the law of continuity which universally obtains; and an attempt to produce *instantaneous* changes, is an attempt to violate nature, and must necessarily fail in the execution.

Applicative Compass for taking Bearings on a Chart. By N. D. Starck, *Esq.*—*Phil. Jour.* No. 47.

This instrument consists of an inner and outer brass concentric circle; the latter of which, when in use, is to be applied to a chart, so that its cardinal points may agree with those of the draft, and its central (metallic) point to be directly over the ship's place. The inner circle is to be set to the variation; and the thread from the centre being laid, will shew either bearings by compass, or true bearings, according to the circle upon which they are read. This instrument may also be used in delineating, plotting, and many other necessary operations.

Description of the Coming-up Glass Telescope, as made by Mr. Thomas Jones.—*Phil. Mag.* No. 88.

This instrument is constructed to enable a person aboard a chasing ship to ascertain whether she lessens or increases her distance from the vessel she is pursuing. To convert a refracting telescope into what the sailors call a *coming-up glass*, the third glass from the eye, in the drawer of the telescope, is divided in two by cutting it across its centre at right angles to its surface; and in using it, these two semi-lenses are separated from each other in the direction of their line of separation. By turning a micrometer finger-screw on one side of the eye-tube, each semi-lens forms an image of the same object; and these images will be more or less separated in the proportion of the distance of the centres of the semi-lenses from each other, which distance is shewn in the revolutions, and parts of a revolution, of the finger-screw that separates them. For this purpose a circular head is fixed on the finger-screw, the edge of which is divided into 100 parts; and in order to know the number of revolutions, a small slip of brass that passes over the graduated surface of the head (and serves as its index for shewing the centesimal parts of a revolution), is fixed to the eye-tube, and has its chamfered edge also divided, each division being equal to one entire revolution of the screw.

The adjustment of this telescope will be obvious enough to those who are acquainted with the application of a thermometer. As to its use; having directed the telescope to the vessel chased, turn the finger-screw till the two images of some well-defined part of the vessel appear to have their extreme edges in contact with each other; then read off the number of revolutions of the screw shewn on the chamfered edge, also the parts of a revolution shewn on the edge of the lead; then, after some time, to know whether distance has been gained or lost in the chase, again bring the edges of the images of the same object in contact as before. If the revolutions of the screw be the same as before, there has been neither gain nor loss in the chase. But if the revolutions be less, the distance from the chased vessel will be greater in the proportion of the difference of these numbers to the former; on the contrary, if the number of revolutions be greater, a gain has been made on the vessel, in the proportion of the difference of these numbers to the number of revolutions and parts of the first observation.

Method of connecting Iron Bars, and coating them with Lead, so as to form solid Pillars for Light-houses, on Rocks covered at high Water, without being subject to Corrosion from the Action of Sea-water. By Cap. Jos. Brodie, *of the Royal Navy.—Transac. Soc. of Arts,* vol. xxii.

In this method, four square rods of cast iron are composed of a number of pieces two feet long, and so rivetted together, that the ends of the component pieces are uniformly distributed, producing the effect of one bar of double the breadth and thickness of the smaller one, a hollow tube of cast iron formed from a number of separate pieces, each about 10 inches long, which, when placed round the connected iron bars and screwed together, form a mould, into which melted lead is to be poured, to coat the rods or bars: by these means, the rods may by small portions at a time be completely covered with melted lead, so as to form a cylindrical pillar apparently of lead. The hollow cylinder is readily formed to any length required, by the junction of a number of semi-cylinders, fitting each other and rivetted together.

After a certain portion of the iron rods is coated with lead, the lower parts of the tube are taken off and placed higher up, so that a few tubes may answer the purpose of coating any length of the iron rods.

Observations.—For a few suggestions relative to different methods of coating iron or steel, the reader may consult page 176 of our second Number.

Description of Varley's Apparatus to prevent the Inconvenience which Artists experience from the Fumes in the Process of Aquatinta Engraving.—Phil. Mag. No. 90.

In the art of aquatinta engraving, the artists experience much inconvenience from the quantity of fumes liberated by the action of the acid upon the copper. To remedy this, the following arrangement has been proposed by Mr. *Cornelius Varley*. Get a frame made of any kind of wood, three or four inches deep, covered with a plate of glass, and open at one side, and let the side opposite to this have a round opening communicating, by means of common iron pipe, with the ash-pit of any little stove or other fireplace, shut up from all other access of air but what must pass through the pipe. Any fumes arising from such a frame will manifestly be carried backward into the iron pipe by the current of air required to maintain combustion in the stove; and will by this mean be carried up the chimney, instead of being allowed to fly about in the apartment. The pipe may be very conveniently used by carrying it down through the table to the floor, and thence along to the chimney, wherever it may be; and when the frame is not wanted, the pipe at any one of the joinings may be made to answer the purpose of a hinge, by which to turn up the frame against the wall, where it may be secured, while out of use, by a button, or any similar contrivance.

Simple and easy Means by which the Harbour of Rye was restored. By the Rev. Dan. Pape.—*Trans. Soc. of Arts*, vol. xxii.

Rye harbour, formerly so safe and convenient for vessels of considerable burden, was in the year 1795, or 1796, in such a state of decay, that a gentleman employed by the Trinity House informed that body in his report, that the harbour was *irreparable*. Advertisements were circulated, inviting gentlemen to come forward with plans of improvement; in consequence of which, Mr. Pape was employed to form a dam: as the form and materials may often be adopted successfully, in places adjacent to seas, rivers, large pools, &c. we give the method of constructing it in the author's own words: "The dam was merely formed of hay, straw, and faggots, pinned down to a *foundation* of *sand* or *silt* by short piles. I formed it of the shape of a double-roofed house, first putting down straw, and then over it hazel faggots, from 12 to 14 feet in length, and afterwards pinning down the whole with piles. I next filled the space between the two roofs with gravel or sea-beach, and secured this also with

faggots pinned down upon it, over which, resistance being precluded from its peculiar form, the influx and reflux of the tides glided so gently, that consequently every probability, not to say possibility, was annihilated of its being ever undermined or blown up.

"It was also necessary that this dam should be put down in one tide, and that the mouth of the cut should be opened in the same time; for it was evident to me that it was impossible ever to cut to sea in any other way. For unless the dam had been ready to turn the water through the cut as soon as opened, and the cut, on the other hand, ready to receive the current the moment the dam began to act, the whole work must have been entirely and unavoidably destroyed by the influx and reflux of the ensuing tide. All this I clearly foresaw; and by procuring a sufficient number of men, nearly three hundred, the business was completely finished, just as the tide touched the foot of the dam; and when it was full sea, the straw of course acted as a receiver and retainer to the *silt* brought in by the tide; which being repeated by each returning tide, the dam soon became entirely fixed, beyond a possibility of ever being destroyed; and it is now so entirely covered, that, if the pier is kept in repair, the dam must ever remain unimpaired by time, and proof against the most violent floods of water."

On a factitious Pozzolana or Water Cement. By M. Dodun.—*Jour. de Phys.*

M. Dodun having during a period of seventeen or eighteen years been engaged in manufacturing a factitious pozzolana, communicated to the National Institute a short history of his discovery.

Situated in the neighbourhood of the Black Mountain near Castlehaudary, it occurred to him, from the appearance of the fragments, that they contained the necessary ingredients for forming a water cement: from some cause or other, these fragments appeared to have been exposed to the action of fire.—M. D. made numerous experiments during fifteen months to ascertain what proportion of lime ought to be employed with these stones, and succeeded in forming a cement, that possessed all the good properties of the pozzolana of Italy, without any of its defects.

M. Dodun proved also by numerous experiments, that cement which acquires solidity most speedily under water, and which hardens the most in it, is not fit to be employed in the open air, however studied and varied were his combinations.

The factitious pozzolana appropriated for works under water, forms in it the most solid body. In the space of three months it becomes a stone that will take a polish. The lime is always restored to the state of carbonate of lime, in two months and a half.

The lime is generally employed in impalpable powder, slaked according to the method of Lafaye, for works exposed to the air. For works that are to be covered with water, the lime is used in the form of a paste: sometimes the lime is used in powder for the same purpose. This difference depends upon the degree of goodness of the lime.

The use of lime in powder has always appeared to M. D. to deserve consideration in the fabrication of mortars or cements. He amalgamates his factitious pozzolana with it in a determinate quantity, as soon as he knows the proportions of the lime necessary: thus he has the facility of manipulating in small quantities. The whole is mixed and deposited in a sack. The mason is thus no longer arbiter of the mixtures, which are so often left to workmen unacquainted with the principles which ought to guide them. The respective quantities both of pozzolana and of lime being always determined by the inventor, he is always certain of the solidity of the cements.

The following are external characters of the quartziferous ferruginous oxydes which form the base of the factitious pozzolana, and the analysis which M. D. made of them about eighteen years ago. The results are given both by the liquid and the dry process, compared with those of the Italian pozzolana.

External characters of the quartziferous oxydes of iron.—Before calcination, their colour is brown-red, or slightly violet. A slight torrefaction gives it either a lighter red or a deep violet tinge; a stronger one converts it either into an intense brown or a violet brown, inclining to black. Their degrees of calcination for use are confined to these two torrefactions.

Under a more prolonged action of fire, the colour acquires a deep black tinge; the substance then becomes porous, and perfectly similar to some volcanic lavas, with which it may then be easily confounded.

The fracture is granulated and somewhat earthy: we may distinguish in it by the naked eye small crystals of quartz, and almost always some angular fragments of grey or milky quartz: with a lens of strong magnifying power we may discover in some specimens, needles of schorl, the amphibole of Haüy, and sometimes small tourmalines.

Their smell is strongly argillaceous when breathed upon.

They do not strike fire with steel, unless the metal meets with some quartzose part.

They do not effervesce with the acids either hot or cold.

The magnet acts slightly upon these oxydes before calcination, and strongly or sensibly after it.

The average weight of the cubic foot is 125°; that of the pozzolana of Italy is 91°.

Analysis by the liquid process.—Silex, iron, alumine, and a small portion of manganese, are found to be the constituent parts of these oxydes. On repeating these experiments many times upon various specimens, M. D. obtained as the average result in the hundred parts, 50 silex, 31 iron, 16 alumine, 3 manganese, or loss.

If we compare this analysis with that of the Italian pozzolana, which contains in the hundred, 51 parts silex, 25 alumine, 16 iron, 3 lime, 5 loss; we are enabled to appreciate their respective properties according to the proportions of their constituent parts. It is in consequence of the excess of alumine that the Italian pozzolanas crack and break when employed in the open air. This defect arises from their great oxydation.

It results from all the facts in the analysis by the dry way, that this oxyde is entirely deprived of its metallic principle, and that its superoxygenation renders it irreducible and refractable.

These oxydes may also be applied to the purpose of painting buildings. After several washings, M. D. extracted from them a beautiful brown-red pigment, equal to that of commerce.

Remarks on the Bursting of two Musket Barrels by a Charge of Gunpowder confined by Sand. By Mr. NICHOLSON.—*Phil. Journal,* No. 45.

A THIN musket barrel was corked at one end, and sand poured in to the depth of 12 inches; upon this was poured 2 inches of gunpowder; and a small glass tube was then stuck into the gunpowder, and the bore of the tube was filled also with gunpowder. The length of the tube was sufficient to reach clearly above the top of the gun-barrel, and all the rest of the space in the barrel was filled with sand lightly poured in. In this state, after using the requisite precautions, a match was stuck into the glass tube, and lighted. The discharge tore the barrel to pieces in the part near the charge; the upper part fell unaltered, and its contents of sand ran out: the lower parts also fell down, but neither its sand nor cork were disturbed, nor was that part of the barrel affected.

A similar experiment was performed upon a thick barrel, with a very full charge of powder; and the effect of the explosion was nearly the same.

The blasting of rocks, the splitting of logs of wood, and the destruction of artillery, when on the point of being aban-

doned to the enemy, are, Mr. N. observes, the leading purposes in which the application of sand to confine gunpowder is likely to become useful.

Observations on blasting Rocks; with an Account of an Improvement, whereby the Danger of accidental Explosion is in a great Measure obviated. By Mr. WILLIAM CLOSE.—*Phil. Jour.* No. 47.

Mr. C. observes that the practice of confining the force of gunpowder by a column of sand in blasting rocks, has been several years used in Furness, of which he has given an account in West's Antiquities of Furness.

Though this method may often be employed with advantage, yet when a strong charge is required, the common mode of stemming must frequently be adopted.

The principal danger attendant on blasting does not consist in stemming upon the charge of powder, but in the subsequent operation of drawing the iron rod, called the pricker, which makes the channel for the priming straw; for it frequently happens that the friction of the lowest part of the pricker against the rock fires the powder, and an explosion is produced, which places the life of the workman in the utmost danger.

To obviate this danger, an improvement has been made by Mr. Fisher of Dalton, which consists in the use of a copper rod, or pricker, for the above-mentioned use, instead of one of iron. Upwards of three years have elapsed since this improvement was adopted; and as no explosion has happened at the end of stemming in that period, at an extensive work where accidents were frequent before, Mr. F. considers the means as almost infallible.

Mr. F. is of opinion that the use of sand in blasting answers the best in deep holes, but that it is more liable to be blown out than stemming. He also considers it as the most advantageous method of working, in driving levels, and blasting in firm rock, to use strong charges of powder, that the stone may be sufficiently broken by the explosion to be removed without much assistance from the hammer, the pick, or the lever; for thus the expedition of the work amply compensates for the small addition which is requisite to a common charge of powder.

Experiments made on a large Scale on the Melting of Iron in a reverberatory Furnace. By G. A. LAMPADIUS.—*Journ. des Mines*, No. 94, vol. xvi.

THE reverberatory furnace used in these experiments consists of three principal parts: 1. the air-tunnel and ash-hole; 2. the fireplace; 3. the hearth and chimney. The air was conducted through a vertical tunnel several yards in length, with its lower aperture over a stream of water. The fuel employed was wood; the bottom of the furnace was an oval cavity capable of containing three or four hundred weight of metal. The flame escaped through a chimney eight ells high.

In using this furnace a multitude of unoxydated particles of carbon were observed in the flame of the closed furnace, which communicate to the latter the property of reducing or disoxydating metal.

Exp. I. *with the simple fire of the furnace.*—Grey, fine-grained cast iron being put into the reverberatory furnace, became covered with a scoria consisting principally of carburet of iron. This scoria could not be removed on account of the metal that adhered to it. The metal being brought to ebullition, carburated hydrogene gas was evolved. After five hours boiling, during which the melted mass was frequently stirred and the scoria mixed with it, it became white and coarser grained, appearing more malleable, but yet not capable of being forged. In the ordinary refining furnace, it was refined sooner than common cast iron. The process of refining iron by the reverberatory furnace shews that the cast iron was here converted into malleable by means of the oxygene contained in the small quantity of atmospheric air, which, jointly with azote and carbonic acid gas, covered the fused metal. This oxygene combined with the carburet of iron, whereby carbonic acid gas and oxyde of iron were formed, and this produced the frothy scoria. This scoria, by reason of its lightness, rose to the surface at the beginning, but was destroyed as soon as the air began to act.

Exp. II. *The fire of the furnace being aided by the vapour of water.*—By igniting the carburet of iron the water was decomposed, and carbonic acid gas, hydrogene gas, and oxyde of iron obtained. This being found to be the case when the experiment was tried on a small scale, the principle was applied to the refining of iron in the reverberatory furnace.

Three hundred weight of cast iron were put into the reverberatory furnace as before, steam was introduced, and the operation proceeded rapidly; but when, at the end of four hours, it was supposed to be finished, the iron was found of fine grain, and full of holes. When treated afterwards in the same manner as

the preceding, it was found less capable of being refined than before. On assaying a specimen in the state in which it came out of the reverberatory furnace, it was found to contain more oxygene than other kinds of cast iron. Half a pound of grey cast iron treated in a retort with four ounces of charcoal, purified of all carbonic acid gas, had been found to yield 32 * cubic inches of carbonic acid gas. A like quantity of white cast iron gave 165 cubic inches of the same gas. Four ounces of the cast iron just taken from the reverberatory furnace, mixed with two ounces of charcoal, gave 96 inches, or 192 inches to half a pound. Thus the proportions of oxygene contained in these different kinds of cast iron are:

In iron super-refined with steam -	192
Common white cast iron - - -	165
Grey cast iron - - - - - - -	96

This super-refined iron is probably formed as follows: the steam is decomposed, and destroys its carburet, as atmospheric air does in the ordinary refining: at the same time it communicates to the iron so large a quantity of oxygene that it was necessary in the refining not only to separate the scoria, but likewise to disoxydate the metal. This experiment, moreover, confirms the property which iron possesses of becoming oxydated at different degrees.

Exp. III. *The fire of the furnace being aided by the action of bellows.*—A bellows being adapted to the reverberatory furnace, a much greater heat was produced than in the two preceding experiments. A very fluid scoria was formed, of a dark brown colour and vitreous fracture, which could not be removed. Stirring the mass produced extraordinary heat with a scintillating combustion. The operation being ended, the iron was found to have lost considerably in weight. Its fracture was silvery, compact, and interspersed with a great number of spherical cavities, indicating the disengagement of a gaseous matter during the fusion. This mass was too small to be refined. Four ounces yielded 87 cubic inches of oxygene gas, consequently nine less than that which had been treated with steam. Thus probably the oxydation was here also too powerful; and as the metal did not become doughy, it must have been supersaturated with oxygene, without passing through the malleable state. The carburet, indeed, must have been totally destroyed, whence the silvery colour.

* Probably this is an error of the press in the original, as it does not agree with the proportion specified in the next paragraph; consequently one of the two must be wrong.

***Report made by Morveau and Chaptal to the National Institute, in answer to the Question, whether those Manufactories which emit a disagreeable Smell, may prove injurious to Health.—Ann. de Chem.* No. 160.**

To arrive at the solution of this question, the authors divide objectionable trades into two classes; the first comprising all those which allow aëriform exhalations to escape from them into the atmosphere, either in consequence of putrefaction or fermentation; which may be deemed nuisances from their smell, or dangerous from their effects: the second including all those, in which the artist, operating by the aid of fire, developes and evolves in air or vapours various principles disagreeable to respire and injurious to health. To the first class belong the steeping of flax and hemp, the making of catgut, slaughter-houses, starch-manufactories, tanneries, breweries, &c. To the second, the distillation of acids, of spirits, and of animal substances; gilding on metals, preparations of lead, copper, and mercury, &c.

The arts of the first class are under certain circumstances really injurious to health: the steeping of flax and hemp, for instance, infects the air and kills fishes. It is therefore almost every where enjoined, that this operation should be carried on at a distance from every dwelling, and in waters the fish of which are of little value.

The exhalations produced in the brewing of beer, the extraction of vegetable colours, the manufactories of starch, paper, &c. do not appear to be equally pernicious. At all events they cease to be dangerous as soon as they are mingled with the open air, and the danger affects only the manufacturers themselves, not the inhabitants of the neighbouring houses. It would therefore be unjust to enjoin the removal of such manufactories.

The fabrication of catgut, and the process of dying cotton red, may be injurious on account of the putrefaction to which the animal substances employed in them are liable. Care should therefore be taken to cause these substances to be renewed so as to prevent putrefaction.

Slaughter-houses exhibit some inconveniences in the same point of view; but these may easily be obviated with due attention.

The fabrication of dried night-soil *(poudrette)* ought to be confined to airy places remote from any habitation; not that the aëriform exhalations from them are considered as injurious to health, but because they are noisome, disagreeable, and difficult to breathe. The exhalations from animal putrefaction appear to be the less dangerous in proportion as the substances that undergo it are less humid.

As to the arts of the second class, or those in which the manufacturer diffuses in the air by the action of fire noxious vapours,

they deserve more particular attention as being more frequently the subject of complaints.

The manufacture of acids.—Sulphuric acid. In the manufacture of this acid it is very difficult to prevent a smell of sulphurous acid being diffused; but where it is skilfully conducted this smell is scarcely perceptible, nor at all dangerous to the workmen, and can give no reasonable foundation for complaint to the neighbours.

The distillation of aqua fortis and spirit of salt (the nitric and muriatic acids) is not more dangerous than that of the sulphuric acid.

The distillation of vinegar is attended with no danger; but when a solution of lead in this acid is evaporated, the vapours become dangerous; their effect, however, is confined to the people who work in the manufactory, and does not extend to those who dwell in the vicinity.

The preparations of mercury and lead, of copper, antimony, and arsenic, the processes of gilding on metals, are attended with some danger to the persons residing in the manufactories, but their effects are bounded by the walls within which they are carried on. Many of their inconveniences have already been prevented by the help of chimnies properly constructed, &c.

The fabrication of Prussian blue, and the extraction of carbonate of ammoniac by the distillation of animal substances in the new manufactories of sal ammoniac, produce a large quantity of fetid exhalations. These, however, are not injurious to health; but, as they are disagreeable, a situation remote from habitations should be chosen. The manufacturer should be obliged to build very high chimnies, whereby the vapours produced may be dissipated in the air.

Hence it appears that there are very few manufactories the vicinity of which is injurious to health. It is therefore recommended to government not to listen too readily to the complaints of jealous neighbours; but to declare publicly, that the manufactures of acids, sal ammoniac, Prussian blue, sugar of lead, white lead, starch, beer, and leather, as also slaughter-houses, are not injurious to the health of the vicinity, when they are properly conducted.

The case is not the same with respect to the steeping of hemp, making catgut, &c. where large quantities of animal and vegetable matter are subjected to humid putrefaction. In all these cases, besides the smell, pernicious miasmata are evolved.

Those manufactories which are not considered injurious to the health of the neighbourhood, ought however to be laid under certain restrictions, in order to prevent their smoke and smell from being diffused in the vicinity. New manufactories of Prussian blue, sal ammoniac, leather, &c. or any article by which disagreeable vapours, or danger of fire or explosions, may be occasioned, should not be admitted within cities, &c. without special authority.

On giving a curved Form to Wood. *By* J. H. Hasszenfratz.—*Journ. des Mines*, No. 96, vol. xvi.

Growing wood may be bended, by reason of its natural elasticicity, for ship-building, or for making the felloes of wheels, &c. For such purposes young trees are bent, and held by means of poles, ropes, &c. in that situation, till they retain the curvature that is intended to be given them. This is the easiest method, but prejudicial to the growth of the trees.

The curving of wood, after being cut down, though more difficult, is more advantageous, as it affords opportunity for a proper selection of timber, to which a suitable curvature may immediately be given. The process generally employed is founded upon the property caloric possesses of augmenting the elasticity of wood by penetrating it, and diminishing this elasticity on quitting it. The application of heat to a particular portion of the wood, while the other is in contact with the air, affects the wood unequally, and causes it to crack or splinter. Ovens or stoves afford an uniform heat, but may scorch the wood. The pliableness of wood depends not merely upon its temperature, but also upon its humidity. Of this twofold influence of heat and moisture we have an example in the structure of the tenon and mortise, where the mortise is only one third of the size of the piece that is to go into it. Heat and moisture are applied to bend timber in three different ways: 1. by boiling water; 2. by steam; 3. by wet, heated sand.

In the first process the boiler is kept full of water, and when the wood is in, the lid is put on, and the water made to boil till the timber is sufficiently penetrated with moisture. This process has the defect of dissolving part of the substance, and lessening the dimensions of the wood.

For the second process, a vapour-stove is used. This stove is composed of a large wooden chest, formed of strong planks, having supports within for the timber that is to be exposed to the action of the steam. The dimensions of the chest depend upon the size and quantity of the timber intended to be softened. Apertures are made on the side opposite to the boilers, and serve to arrange the timber on the supports. It is usual to leave the chests exposed to the air externally; but it would be of advantage to cover the planks with some substance that is a bad conductor of heat, to confine that which is disengaged from the steam within. The vapour is conveyed to each story of the chest by tubes from the boiler. It impregnates the wood with moisture, increases its elasticity, and renders it fit to be bent. This process is easy, and not expensive; but as the vapour-stoves cannot im-

part a temperature higher than that of boiling water, it is insufficient for large timber.

To obtain a higher temperature, the sand-stove was invented; this is formed of four stones, or brick walls; in the middle are two furnaces, which communicate with several circular flues, for conveying the heat, the heated air, and the smoke, to the chimnies at each end. Over these flues are plates of metal, which form the bottom of the chest in which the sand is placed; the flame and smoke circulating in the flues heat the plates, and these plates heat the sand. This stove is an imitation of the sand-baths that have long been employed for chemical and other processes. Sand being capable of a much higher temperature than boiling water, the timber may be subjected in such a stove to a much more powerful heat; but in order to prevent its being thereby scorched, steam must be used at the same time. For this purpose, one or two boilers filled with water are placed in the middle of the stove; the steam created by their ebullition impregnates the sand with humidity, which likewise penetrates the wood, and prevents it suffering any perceptible injury from the heat. The sand-stove is covered throughout its whole length, to retard evaporation and produce an accumulation of heat. The pieces of wood are introduced into the stove at the two ends, placed lengthwise on gratings, and covered with sand. When sufficiently heated and penetrated with moisture, it is bent into the curvature required. It may be bent either horizontally or vertically: the former is used for pieces of smaller dimensions and more considerable curvature. The force that produces the curve may be applied by means of cords, pullies, and even capstans; sometimes weights may be sufficient. The piece must be kept in the form which it is intended to take, and thus left to grow cold and dry, when it will retain the curvature given to it.

N. B. This memoir is accompanied with an engraving of the stoves, which is given in the Repertory of Arts, No. 40, New Series, with the translation at length; and likewise in No. 45 of Nicholson's Journal.

On a Project for extended Roads, on the Principles of the inclined Plane. By Mr. CUMBERLAND.—*Phil. Jour.* No. 48.

THE plan proposed by Mr. C. is: That all dispatches and post-letters may, wherever it is compatible with the inclination of the ground, be conveyed ten or fifteen miles to and from London, by means of *iron or wooden shells of a globular form, rolling in a cylinder of brick or stone.* When closed and locked, a due momentum being given at a proper elevation, it is easy to see (Mr. C. observes), that their speed and security must far surpass any

other mode of conveyance at present known; and all that would be necessary in addition to the machine, would be to have proper beds of sand, or wool-bags, to blunt their projectile force at the end of their career.

Improvement in applying the Points in electrical Machines. By Mr. G. J. Singer.—*Phil. Jour.* No. 46.

In the ordinary construction of electrical machines the collecting points are fixed, and liable by accidental motion to scratch the glass: to obviate this inconvenience, Mr. S. places his points in a cylindrical wire, terminated by smooth wooden balls, whose semi-diameter is less than the length of the points: this wire is moveable on its axis, by means of a spring socket annexed to the stem which enters the conductor. These points may be placed at any required elevation, and the greatest intensity any variation in their situation produces be obtained. When the points are elevated a little above the horizontal line, the danger of scratching the glass is effectually prevented, by the balls coming in contact while the points are kept at a small distance.

Experiments on the Electricity of metallic Filings sifted through Metal. By Mr. W. Wilson.—*Phil. Jour.* No. 42.

This communication was occasioned by an objection made by Mr. Cuthbertson to the production of electricity by mere separation of metals. Mr. Wilson, in reply to the objection, remarks, that the metallic filings, in the experiment, touch the sieve, are separated, and then touch the receiving metal; that, as the degree of electricity varies with the sieve used, it does not depend on the latter contact; and that, as in the first contact, there is no insulation, it must, of consequence, depend on the *separation*.

To settle the matter decisively, Mr. W. made these experiments: 1. He fastened a piece of card into a stick of glass, and then rubbed it over with strong gum water, and covered it with zinc filings, so that it had a surface of zinc filings when dry. From a heap of such filings as many were taken up with this little shovel, as could be without touching it with any thing else, and they were permitted to fall very slowly upon a piece of bright sheet copper, fixed obliquely upon the cap of an electrometer, its lower end being formed into a receptacle to contain the filings. In this operation the copper plate was not sensibly electrified. 2. A copper sieve was used instead of the shovel; the same filings were sifted through it upon the same copper on the electrometer: the consequence

was, that the gold leaves diverged with positive electricity, discharging themselves against the strips of tin foil, on the inside of the glass, *ten* times before the whole of the ounce and half of filings were sifted into it.

Hence Mr. W. concludes, with much reason, that *separation* was the sole cause of this electricity: and he suggests, that electric excitation is probably a fact of a similar kind.

American boring Tool.—Phil. Jour. No. 43.

THIS is a very simple borer, consisting merely of the common centre bit of the carpenter's, followed by a wide, flat thread-skrew, hammered up from a plate of iron or steel. The peculiar property possessed by this instrument is, obviously, that it clears the cutting without requiring to be drawn out, as is the case when the auger, the gimlet, and similar tools are used.

Observations.—This property, however, it possesses in common with the carp's tongue cutter used in boring of ordnance; and it seems subject to the same disadvantage, viz. that it cannot be adopted with effect in boring vertical orifices, but only in horizontal ones, or those which are but slightly inclined to the horizon. Still we do not conceive this circumstance will materially limit its use.

On mechanic Power and its Measure, as deduced from animal Efforts. By Mr. J. C. HORNBLOWER, *and Mr.* O. GREGORY. *—Phil. Jour.* Nos. 42, 43, 44, 45.

FOUR letters, wearing a controversial aspect, have been written on this subject, by Mr. Hornblower, an ingenious civil engineer, and Mr. Gregory, one of the mathematical masters at the Royal Military Academy. Several of the observations in these are well worthy the attention of the practical mechanic; but they do not appear susceptible of a clear representation in an abridged form. We mention them in this place, in order to introduce a brief account of a method contrived by Mr. Gregory for *measuring the power exerted by horses when working in circular walks.* The proposed apparatus and method is as follows: Let two horizontal horse-poles be fixed to the vertical shaft, so that they shall together constitute a diameter of the walk, and let two horses be employed together; one of them working the machine by drawing at the extremity of one of the poles; but instead of the transverse splinter-bar, to which the harness is attached, being simply hung upon the hook at the end of that pole, let a

good spring steelyard between the cross-bar and the hook, the graduations of which shall, when the machinery is put into motion, indicate the resistance (in lbs.) overcome by the animal, including the weight of the mass moved, the friction, &c. Near the extremity of the opposite horse-pole, let there be fixed a strong and correct common steelyard, whose divisions shall shew the various weights from 40 or 50 to 200 lbs. Let the cord which is fastened to the shorter arm of this steelyard pass through a vertical orifice made in the horse-pole, and then (with as little friction as possible) over a pulley; and thus, being turned into the horizontal direction, or rather inclining a little upwards, let it be fixed to the cross-bar of the harness of a second horse, equal in point of strength to the former. Then, if the two horses thus attached to the ears of the respective horse-poles, be made to pass over the walk in the same direction, following each other constantly at the distance of a semi-circumference; while that which draws by the spring steelyard overcomes the whole pressure and resistance opposed by the work, the other which draws at the opposite horse-pole by the cord running over the pulley, will raise the weight of the steelyard; which, therefore, by being moved to and fro upon the longer arm of that steelyard, may be brought to exhibit an exact counterpoise, or measure of the exertion and power of the horse. And in order to ensure the greatest degree of accuracy in this respect, Mr. Gregory recommends that the motion of the two animals, and the position of the weight on the lever steelyard, should be so adjusted, that the same weight should be shewn by the graduations of both steelyards.

Such is the general contrivance; those who have opportunities of making experiments upon the strength of horses working in walks of different diameters, may easily adopt it. It can scarcely be necessary to suggest the propriety of making the experiments of a sufficiently long duration; because short and irregular efforts are always erroneous in excess. The same kind of contrivance may, by obvious modifications, be fitted for the determination of the strength of horses drawing in waggons, of men working at capstans, &c.; and it is much to be wished, that extensive experiments, having these objects in view, were frequently tried; as they would tend to throw light upon a branch of knowledge which, though important, has been too little attended to.

A Press for preserving botanical Subjects. By Mr. THOMAS HARRISON.—*Phil. Jour.* No. 44.

MR. Harrison, after pointing out the principal objections to the methods now in use, gives a description of his own press, which is an improvement upon the contrivance of Mr. Whately.

This new instrument consists of a series of 17 oblong boxes each, excepting the uppermost and lowermost, being made of four sides of well-seasoned oak-wood, two inches deep and one fourth of an inch thick, dove-tailed together; the two end pieces of which have two notches each in the middle, for the convenient admission of the fingers in lifting it; and the bottom consists of canvass glued and nailed to the wooden frame: in each corner is fixed a small triangular piece of wood, reaching half an inch from the bottom upwards. These boxes are so made, as to be placed one within another successively upwards, and of course become smaller and smaller by a regular gradation. The lowest of the 15 boxes with canvass bottoms measures, on the outside, 20 inches by 16; and the highest of those 15 measures 12 inches by 8. The bottom box, or carriage, on which all the others are supported, is much stronger, its sides being two inches deep, and three quarters of an inch thick: its bottom is of wood of the same thickness, perforated all over with holes a third of an inch in diameter, and rests on four iron casters, one at each corner, to render the whole more easily moveable; and at each end there is an iron handle. This box is 20 inches by 16 within, and will, therefore, barely receive the largest of the boxes with canvass bottoms. The uppermost, or 17th box, is of the same construction as the canvass ones, excepting that its bottom is of wood of the same thickness as its sides, with a number of holes pierced through, of the same magnitude as those in the carriage, and having canvass glued to its under side. To complete this press, two folds of blotting paper are to be placed over the holes in the bottom of the carriage; in which, as well as in all the canvass boxes, fine river sand, washed and sifted, must be put to an inch in depth; such sand must be made level on the top by drawing over it a ruler that reaches one inch into each box. These boxes are placed one within another, and each, by containing an inch depth of sand, raises the incumbent frame one inch; so that when they are thus charged, and placed one upon another, the whole constitutes a truncated pyramid of 18 inches high, and weighing about 1 cwt. The uppermost box may be filled either with sand or shot, according to the weight required. To this box Mr. Harrison has added a cap, formed of the sides of three boxes; but this is not an essential part, and may be varied at pleasure, to suit the contriver's notions of elegance and uniformity. In using this press, the specimens are laid between folds of blotting-paper, and the pressure is manifestly regulated by the respective number of boxes above each.

As to the effects and advantages of this contrivance, it is obvious, that the holes in the lowest and uppermost boxes are to admit of the circulation of air, and the evaporation of moisture; and the small triangular pieces of wood in the corners of each box, are to prevent the upper boxes from pressing solely on the

canvass bottom of the lowest box, when any number are lifted together. At first sight some may suppose that these would impede the pressure of the sand when placed in the press; but that this is not the case will be evident when it is recollected, that while these pieces are only half an inch deep, each box contains an inch depth of sand. In this construction the sides of the boxes are moveable in a vertical direction, and sustain no pressure from the boxes above them, so that the plant is placed as though in a heap of sand.

Account of a singular Fact of the invisible Emission of Steam and Smoke together from the Chimney of a Furnace, though either of them, if separately emitted, is visible as usual. By D. GIDDY, *Esq. M. P.— Phil. Jour.* No. 45.

THE steam engine was adapted to the purpose of moving waggons, and every accessary part contrived as light and simple as possible. The steam, after work, was thrown into the chimney, many feet from the fire: neither smoke nor steam was visible. When the smoke was shut off, the steam became visible, and when the steam was shut off, the smoke was visible. The draft was found to be increased by the admission of steam into the flue.

To elucidate these phenomena, Mr. Nicholson made an experiment. A glass tube was stuck through a cork, and this was inserted in the neck of a retort, in which water was boiling over a lamp: the steam was emitted through this aperture in a visible jet, but when it was passed over the flame of a candle it became invisible. The steam, however, was not found to be decomposed. In Mr. Giddy's experiment, there seems reason to conclude, from the disappearance of the dense smoke, that the charcoal was oxygenated and gasified. This might be ascertained by collecting the products in such an experiment.

On Fish thrown up by a Volcano of Peru. By M. HUMBOLDT.— *Jour. de Phys.*

AMONG the great number of various facts which M. Humboldt has collected in his travels, one of the most extraordinary is the following, which he communicated to the National Institute.

Many of the volcanos of the Cordilliers of the Andes throw up at intervals eruptions of mud mixed with vast quantities of fresh water, and, what is extremely remarkable, an infinite multitude of fishes. The volcano of Imbaburu, for example, once threw up such a vast number of them near the village of Iborra, that their putrefaction caused a sickness. This phenomenon, astonishing as it is, is not however unfrequent;

on the contrary, it very often takes place; and public authority has preserved accounts of the periods at which this has happened, in an authentic manner, along with those of the earthquakes. What is very singular is, that the fish are not broken in the least, although their bodies are very soft; they do not even seem to have been exposed to a great heat. The Indians assert that they even sometimes arrive still alive at the foot of the mountain.

Sometimes these animals are ejected from the mouths of the crater, sometimes they are vomited forth at the lateral cavities; but always at from 12 to 1300 toises above the level of the neighbouring plains. M. Humboldt thinks that they live in the lakes situated at this height in the inside of the crater; and what confirms this opinion is, that the same species is found in the rivulets which run at the foot of these mountains. It is the only species of fish which lives at the height of 1400 toises in the realm of Quito.

This species is new to our naturalists. M. Humboldt has delineated it on the spot, and has given it the name of *Pimelodrus Cyclopum*, which (he asserts) signifies *thrown up by the Cyclops*, a name analogous to their origin: the figure of this fish may be seen in the first part of the Zoological Observations, which will speedily be published.

Process for watering Hemp in two Hours. By M. Bralle.—*Bib. Phys. Econ.*

Green soap (savon verd) 67 grams (12oz.) is to be added to 110 kilograms (220lb.) water boiling hot; when the soap is dissolved, 11 kilograms (22lb.) of hemp is to be immersed, so as to be entirely covered by the liquor, the vessel closed, the fire put out, and the hemp left to macerate for two hours: a smaller portion of soap may do, but the above was the proportion used by M. Bralle in his public experiment: for a complete steeping, it may be as 1 to 48 of the hemp, and 650 water.

Several steepings may be made in succession, care being taken to add soap each time, to replace what has been absorbed, and to heat the water to the former temperature. The same water may be employed for fifteen days continually.

When the bundles of hemp are taken out, they are covered with straw, that they may cool gradually, without losing their humidity. Next day they are to be spread on a floor, the bands shifted, and a heavy roller passed over them; after which, the hemp separates easily from the reed, by beating. The hemp thus separated is spread on the grass, and turned, and after five days removed to the warehouse. In steeping the hemp, the bundles should be kept in a vertical position, as the operation is found to succeed better so than when they are horizontal.

The advantages of this method are, 1st, the superior speed of the process to that in common use; 2d, its being practicable at all seasons; 3d, its not being injurious to health, or producing any bad smell; 4th, a saving of expense, when proper apparatus is used in the operation; 5th, a superior quality of the hemp so prepared, and less waste produced, so that nearly a fourth more hemp is got from the same quantity of raw materials; 6th, extending the culture of hemp to all situations, which can now be carried on only in the vicinity of running waters.

A very good apparatus for the process is formed by a boiler, and wooden tubs, with covers, for steeping-vessels.

Description of the Bavarian Method of evaporating Salt Waters. By Mon. BONNARD.—*Bulletin des Sciences,* No. 90.

THIS method has been introduced into the salt-work of Moyenvie by M. *Cleiss*, inspector of the salt-works of Bavaria.

The pans are formed of plates joined by their edges, which are turned downwards, and consequently without the pan: they are solidly united by a piece in the form of a square gutter, which receives the edges, and is secured by a great number of screws.

The evaporating house contains six pans, disposed in two rows: these pans have different uses, which require a particular arrangement.

That in the middle of the back row is the smallest; it has no particular fireplace, but is heated by the junction of the chimnies from the other fireplaces. The salt water deposits its impurities in it: it is called the small pan.

From the small pan the salt water passes into the graduating pan, which is lower than the first, and placed in the middle of the front row; it is there kept in a state of constant ebullition: the water is concentrated in it 20 degrees, and deposits a part of its sulphurated lime.

From the graduating pan the salt water passes into the preparing pans, which are lower than it, and situated at the two extremities of the back row; there it is also kept constantly boiling: it is completely concentrated, and deposits all its sulphur of lime; it is then passed into the crystallizing pans, placed still lower than those of preparation, at the two extremities of the front row; there the water scarcely boils, and the salt crystallizes.

Each pan, except the small one, has a particular fireplace, the chimnies of which pass round the sides of the pan: they unite under the small pan, by which means little heat is lost.

These pans are placed two and two, in chambers of wood, the joinings of which are well secured: these chambers are low, and their ceilings are perforated in the middle with holes terminating in a tube, by means of which the aqueous vapour is disen-

gaged with rapidity. The chambers for the crystallizing pans have their ceilings pyramidal, or in the form of a reversed hopper; while that over the small pan and the graduating pan is flat.

The saline waters are passed successively into these four kinds of pans: the workmen penetrate into the chambers, in the midst of the vapours, to open the communications between the pans. This operation is performed every six hours, and the water in each pan is restored to the level at which it stood six hours before. Every three hours the salt in the crystallizing pans is collected. It is brought with scoops to elevations on the front edge of the crystallizing pans, where it drains; it is afterwards carried into drying rooms, which surround the outside of the chambers: these are spaces covered with iron plates; they are warmed by heat-tubes passing from the fireplaces.

Every eight days they take away the sulphate of lime, throw out the mother waters, and break the shell; that is to say, the incrustations of salt which adhere to the bottoms of the pans: every twenty-four days the work is entirely stopped, to repair the pans, which is performed by the workmen themselves. It has been found that this method of evaporation saves more than one third of the fuel.

An improvement has been made lately in this process at Dieuse: the small pan has been suppressed, and the drying pans have been replaced by auxiliary pans, in which a coarse salt is made.

The heated drying rooms are useless, when the humidity of the salt arises from the muriate of lime which it contains.

Observations.—The principal difference of this apparatus from those in common use consists in the preparatory pans, and in the method of uniting the iron plates to form the pans themselves.

By the use of the preparatory pans, the marine salt can be obtained more pure, from its leaving behind in them the earthy salt, with which it is mixed; and much saving will also arise in fuel from this method, obviating the necessity of altering the temperature of the liquor at different parts of the process; in the course of which, parts of the apparatus are cooled in the old way, which must be again heated, but which always remain at the same temperature in the mode of management described.

The method of uniting the iron plates, to form the pans, it is also apprehended will make a much tighter joint than that in use for the same purpose in this country, and less liable to give way: however, it seems that rivets would do as well for fastening the bent edges of the plates as the screws mentioned, and would certainly cost much less; but perhaps the use of the screws may afford a facility to the workmen for the repair of the pans, which may amply pay for their cost. Mr. Manley, near Chester, obtained a patent in 1801 for a method of making salt, in many respects similar to the above described; for which see Repertory of Arts, vol. xv. First Series.

CHEMISTRY AND MINERALOGY.

Experimental Investigations concerning Heat. *By* Benj. *Count* Rumford.—*Phil. Journ.* Nos. 46 and 47.

§ 1. *Account of a new Experiment on Heat.*

Having found that metallic bodies exposed in the free air of a large apartment are more speedily heated and cooled when their surfaces have been blackened, than when clean and polished, the Count wished to ascertain whether they followed the same law in small closed spaces. For this purpose he suspended a cylindrical vessel of thin brass in the centre of a larger vessel, so as to leave on all sides an interval of one inch between them. The inner vessel was filled with hot water, and a thermometer inserted in it. This instrument was then plunged in a mixture of pounded ice and water. The results afforded by a series of experiments made with two such instruments, both of the same form and dimensions, but with this difference, that in the one the exterior surface of the small vessel, and the interior surface of the great vessel were polished; and in the other the like surfaces were blacked; prove that the blackened body constantly cooled in less time than the polished one.

From a comparison of the results of this experiment with that formerly made upon the cooling of bodies in a large chamber, it appears that the law which they follow is nearly the same in both cases.

From reflecting on the consequences which ought to result from the radiations of bodies, on the supposition that the temperatures of bodies are always changing by means of these radiations, the author is led to the following conclusion: If the intensities of radiated heat be inversely as the squares of the distances, bodies will cool in the same time in an enclosed space of the same temperature, whether it be large or small. This position is confirmed by the experiment above described.—The effect produced by the air in cooling a heated body, exposed in a close place, is inconsiderable. Former experiments prove, that when a hot body cools in tranquil air, one twenty-seventh only of the heat left by this body is communicated to the air, all the rest being carried into the surrounding solid bodies by radiation.

§ 2. *Experiments on cooling Bodies.*

Many experiments have been made at different times, to determine what is called the conducting power of different substances with regard to heat. Glass is allowed to be one of the

worst conductors. When it is proposed to confine the heat in a body, the temperature of which has been raised, care is taken to surround the heated body with substances known to be bad conductors of heat. With a view to ascertain the manner in which the cooling of bodies is effected, the Count made the following experiment: A thick glass bottle and a thin one of tin were prepared, weighed, and measured. After having been filled with boiling water, they were hung up to cool in tranquil air; when it was found that the bottle of glass was cooled almost twice as quickly as that of tin.

This result appears to throw great light on the operation of the communication of heat. If we admit the hypothesis, that hot bodies are cooled, not by losing or acquiring some material substance, but by the action of colder surrounding bodies, communicated by undulations or radiations excited in an etherial fluid, the results of this experiment may be easily explained; but if this hypothesis be not adopted, they seem inexplicable. Though it might be suspected, that the air attached by a certain attraction, but with unequal forces, to the surfaces of the two bottles, might have been the cause of this remarkable difference in the time of their cooling; but the results of former experiments of the Count shew, that this cause is not sufficient to explain the facts. All metallic bodies shew the same disposition to cool, nor is any thing more required, in order that the cooling shall be effected in the same time, than that the external surface of the vessel be truly metallic, and not covered with oxyde, or other foreign bodies. On inquiry, what quality all metals might have in common, and in the same degree, to which this remarkable equality of their susceptibility of cooling may be attributed, it is to be found in their opacity, whereby the heat is reflected. The usual comparison of a heated body to a sponge containing a certain quantity of water is incorrect. Were it just, more caloric would be emitted by a rough surface than by a smooth one. Experiment however shewed, that two equal vessels of brass, the one polished and the other unpolished, cooled in the same time. We ought carefully to distinguish those surfaces which appear unpolished to our eyes, but which, in fact, are not so, from those which reflect little or no light. Metals, if naked and clean, are not less reflective for losing their glaring lustre. This position all the Count's experiments concur to prove.

§ 3. *Experiments tending to shew, that Heat is communicated through solid Bodies, by a Law which is the same as that which would ensue from Radiation between the Particles.*

The object of these experiments was, to ascertain the laws of the propagation of heat through solid bodies, particularly metals.

Two cylindrical vessels of tin were fastened together by means of a solid cylinder of copper. The vessels were filled with water,

one at 212° and the other at 32°. For the purpose of observing the change of temperature, which must necessarily take place in all the interior parts of the copper cylinder, three thermometers were introduced into three holes made in it, one in the middle of the cylinder, the others midway between the centre and either extremity. The hot water was kept constantly boiling by means of a lamp, and the cold water constantly at the temperature of melting ice by the addition of fresh portions of ice.

The thermometers were not noticed till nearly stationary, when that nearest the boiling water stood at 160°, and never rose above 162; that nearest the cold water, at 105, and varied between that and 107½; that placed midway, at 130, and varied between that temperature and 133.

Before examining more minutely the results of this experiment, the Count endeavours to shew what ought to have been its results, on the supposition that heat is propagated, even in the interior of solid bodies, by radiations emanating from the surfaces of their component particles.

On this supposition we must necessarily consider the particles that compose bodies as being *separate from each other*; and there are many phenomena which seem to indicate that all solid bodies are thus formed.

To see by what law heat would be propagated in a solid cylinder; suppose the cylinder to consist of only three particles of matter, A C E, placed at equal distances; the extremity A being constantly kept at the temperature of boiling water, and the other E at that of congelation. From the result of a former experiment of the Count's, it appears that in this case the middle particle C would acquire by radiation a temperature which would be the arithmetical mean between those of A and E, or 122°. Suppose two more particles interposed, these would each acquire the mean temperature between the middle particle and the nearest end particle, and therefore would not alter the temperature of that middle particle. And by the same reason it would not be changed by other particles interposed; but the thermometer would remain equally stationary if the number of intermediate particles were increased till they had that proximity to each other, which is necessary to constitute a solid body. If, instead of a single row of particles in a right line, there were a bundle composed of an indefinite number of such rows placed side by side, forming a solid cylinder, the temperature in the different parts of the line A E would remain the same.

From this reasoning we may infer, that the temperature of the different parts of the cylinder should decrease in arithmetical progression, from one end of the cylinder to the other. But this is true, only in the case of the surface of the body being completely insulated, so as to be no way affected by the action of the surrounding bodies, which is not impossible. Our experi-

ments are always thus influenced, and the progress of the heat therefore differs widely from this law. The atmosphere will affect the cylinder by cooling its hot part and heating its cold part. If one extremity of the solid body be at the temperature of the air, and the other at a higher, the surface will be every where cooled, but most so where the heat is the greatest. The change is in proportion to the difference of temperature; whence the temperature will be in geometrical progression, and may be represented by a curve, which, however, on comparison of theory with experiment, is found to differ greatly from the logarithmic. This great difference the Count ascribes to water being a bad conductor of heat, and the currents in the cold water being inconsiderable. This he proves by an experiment, wherein, upon stirring the cold water, the thermometers all fell very considerably. After giving a diagram to represent these effects, he deduces the following facts from inspection of the figure: 1. That the decrease of temperature was every where much more rapid when the cold water in contact with the extremity of the cylinder, was agitated, than when at rest: 2. that the extremity of the cylinder in contact with the water was constantly near 30° colder in the first case than in the second: 3. that the progress of refrigeration was every where nearly such as the theory before given points out.—Agitation greatly increased the effect of the boiling water likewise. The difference between the experiment and the theory confirms its truth, because the divisions of our thermometers are inaccurate. To improve this instrument, is therefore an object of importance; but it is the air thermometer that deserves chiefly to be attended to, and which must ultimately afford the most accurate measure of heat that it is possible for us to procure.

§ 4. *The Heat produced in a Body by a given Quantity of solar Light is the same, whether the Rays be denser or rarer, convergent, parallel, or divergent.*

Whether the quantity of heat generated by the solar rays be always in proportion to the light absorbed, is a very important question, which has not hitherto found a decisive solution. It does not follow from reasoning that the absolute power of the rays to produce heat, can be increased by condensing them.

The following is an outline of the experiments whereby the Count confirmed this fact.

Two convex lenses perfectly similar were used to throw the sun's light upon flat tin boxes, containing water, and blackened on their surfaces. The temperature of the water in each was shewn by a thermometer.

Exp. 1. The light being admitted through equal apertures, the solar spots from the lenses were of 6 and 24 lines diameter.

The densities of these equal quantities of light were therefore as 16 to 1; but both the vessels were heated in equal times.

Exp. 2. The diameters of the spots were as 4¼ to 27; the densities of the light at the surfaces of the reservoirs as 32 to 1. The densest light afforded rather less heat: hence light does not generate more heat absolutely by being condensed.—In both these experiments the solar rays striking on the reservoirs of heat were *convergent*, and equally so on both sides.

Exp. 3. One vessel being exposed to the parallel rays of the sun without interception, it was heated more quickly than the other by a spectrum of 6 lines diameter. This difference is attributed to light being lost in passing through the lens; but as we know not exactly how much light was lost in this manner, the experiment is not decisive.

Exp. 4. was made with equal apertures and spectra; but the one being *within* the focus, was formed by convergent rays; and the other, *without*, by divergent rays. No sensible difference occurred.

From the results of all these experiments the Count concludes, that the quantity of heat excited or communicated by the solar rays is always as the quantity of light that disappears.

Analysis of Dr. JAMES's *Powder.—Ann. de Chem.* No. 163.

M. CADET, after observing that the analysis of James's powder, published by Dr. Pearson, will not enable any one to imitate this celebrated compound, communicates a process whereby a M. Pulley, a chemist of Naples, asserts that he has perfectly analyzed it, together with his method of forming it synthetically.

Analysis.

1. The powder was infused in hot distilled water; the water was separated by the filtre, and being afterwards evaporated, it yielded a salt, having all the characters of sulphate of potash. This salt, treated with barytes, gave a precipitate of sulphate of barytes.

2. It having been perceived, previous to the decomposition of the salt by barytes, that the solution contained an excess of free potash, in order to ascertain whether this potash did not hold oxyde of antimony in suspension, the liquor was decanted, to separate it from the sulphate of barytes, and sulphurated hydrogene poured into it, which immediately formed *sulphur auratum* of antimony. The free potash therefore was combined with a portion of antimony, at the minimum of oxydation.

3. The washed powder (1) was heated with nitric acid, which dissolved the phosphate of lime, without attacking the oxyde of antimony at the maximum. This oxyde was separated

from the solution; ammoniac was poured into the liquor, which precipitated the phosphate of lime.

4. The phosphate of lime was decomposed by weak sulphuric acid, and afterwards recomposed, in order to ascertain the proportions.

5. The oxyde of antimony at the maximum was dissolved in muriatic acid. This solution, treated by sulphurated hydrogene, gave a hydrosulphuret of antimony, containing more sulphur than the kermes mineral, and less than the *sulphur auratum*.

According to his analysis, James's powder consists of

Oxyde of antimony at the maximum -	7
Phosphate of lime - - - - -	4
Sulphate of potash - - - - -	4½
Free potash, holding oxyde of antimony at the minimum - - - - - -	3½
	19

Synthesis.

To recompose this powder, take

Sulphuret of antimony - - - - -	2 parts
Calcined phosphate of lime - - - -	1½
Nitrate of potash - - - - - -	4

Pulverize, mix, and triturate these substances, then heat them strongly in a close crucible: during this operation, the oxygene of the nitric acid, combining with the sulphur of the sulphuret of antimony, converts it into sulphuric acid, which uniting with a portion of the potash, forms sulphate of potash: the rest of the free potash retains oxyde of antimony at the minimum. The white powder which remains in the crucible is the same substance as the James's powder.—M. Pulley asserts that he has analyzed the powder prepared in this manner, and fouud it to contain the same principles and the same proportions as the James's powder procured from London, which he had analyzed.

On the Deliquescence and Efflorescence of Salts. By M. Cadet.—*Jour. de Phys.*

The deliquescence of a salt is acknowledged to be occasioned by the attraction of the salt for the water contained in the atmosphere, and the efflorescence of a salt by the attraction of the atmosphere for its water of crystallization.

This attraction has been found to vary in the different salts, whether deliquescent or efflorescent; but the variations dependant upon the state of the atmosphere, and the degree of saturation of the salt, have not yet been noticed.

The deliquescent salts may naturally be supposed to act as such in proportion to the quantity of water which the air held in solution or in suspension. On the other hand, this action ought

also to be influenced by atmospheric pressure and the variations of temperature. Deliquescent salts may likewise be supposed to attract most when least saturated. Thus by comparing the deliquescence and efflorescence of salts with the state of the different meteorological instruments, the author hoped to obtain results sufficiently constant to establish a theory of deliquescence or efflorescence. On trial, however, he found not a single salt which seemed to have the least conformity with the state of the barometer, hygrometer, or thermometer.

Efflorescent salts.—Sulphate, phosphate, and carbonate of soda, exposed to efflorescence, shewed the following results:

Sulphate of soda left to effloresce 61 days, lost 203 grains of water.

Phsophate of soda	-	39	-	91
Carbonate of soda	-	51	-	86

It should seem from this state that these three salts ought to be classed in the preceding order; but it must be observed that salts contain more or less water in proportion as they crystallize slowly or rapidly. The number of days employed in the efflorescence of these salts should vary both in proportion to the water they contained, and to the extent of surface which they exposed to the action of the ambient atmosphere; the time of their efflorescence therefore cannot enable us to appreciate the force of their attraction for water.

Deliquescent Salts.—Table of deliquescent Salts, in the Order of their Attraction, estimated by the Quantity of Water absorbed.

	Days employed in their saturation.		Water absorbed.
Acetite of potash -	146	-	700 grains.
Muriate of lime -	124	-	684
Muriate of manganese	105	-	629
Nitrate of manganese	89	-	527
Nitrate of zinc -	124	-	495
Nitrate of lime -	147	-	448
Muriate of magnesia	139	-	441
Nitrate of copper -	128	-	397
Muriate of antimony	124	-	388
Muriate of alumine	149	-	342
Nitrate of alumine	147	-	300
Muriate of zinc -	76	-	294
Nitrate of soda -	137	-	257
Nitrate of magnesia	73	-	207
Acetite of alumine	104	-	202
Acid sulphate of alumine	121	-	202
Muriate of bismuth	114	-	174
Acid phosphate of lime	93	-	155
Muriate of copper	119	-	148

On examining this table it appears that the duration of the absorption is not in any proportion to the quantity, nor the force of attraction to be estimated from the rapidity with which the bodies unite. However, although the greater or less facility with which deliquescent salts saturate themselves with water cannot be accounted for, the rapidity of their saturation is not a matter of indifference. For instance, it is probable that the muriate, and more especially the nitrate of manganese would produce with ice a more intense cold than can be obtained by any of the means hitherto used for producing artificial refrigeration.

On comparing salts with respect to the proportion of the base or of the acid which constitutes them, it does not appear that their deliquescence depends on the proportion of their component parts, nor upon the peculiar nature of these component parts themselves. Generally, deliquescent salts increase their weight in a diminishing proportion, according as they approach saturation. Some salts increase and diminish successively in weight. Such oscillations and retrograde movements take place only once; and when the salt has absorbed a certain quantity of water, there is a progressive increase till perfect saturation. These anomalies observed again, and compared with experiments made on other salts that do not exhibit them, may tend to make us acquainted with all the causes that produce efflorescence and deliquescence, since they present each phenomenon successively. It might probably then be found that a relation really exists between the meteorological variations and the alterations of the salts. Such a research, the author thinks, would require more than three thousand experiments.

Chemical Experiments on Mercury. By Messrs. BRAAMCAMP *and* SIQUEIRA-OLIVA.—*Ann. de Chim.* No. 161.

THESE experiments have for their objects, 1. To ascertain the action of the phosphorous acid, of the phosphites, and of phosphorus, upon the oxydes and salts of mercury; 2. The analysis of some of the mercurial salts by means of the phosphorous acid; 3. The action of the oxymuriatic acid.

1. *Of the action of the phosphorous acid upon the oxydes of mercury.*—Ten grammes of red oxyde being placed in contact with phosphorous acid, the oxyde became grey. The mixture being boiled, running globules appeared, which led to the supposition that the phosphorous acid had become phosphoric acid by taking oxygene from the oxyde, but that the phosphoric acid, as it formed, might have dissolved some of the oxyde. On filtrating,

Comparative Experiments on Mercury.

and treating the liquor by ammoniacal hydrogene, but very slightly. Ammonia or its presence of mercury appeared. The residue, washed and dried, gave the grammes of mercury. Hence it was concluded that the red oxyde of mercury contains acids by weight of oxygene.

The experiment shows a new mean of analyzing the mercurial oxydes which seem irreducible by sublimation, which is at once less expeditious and attended with the inconvenience of not giving with accuracy the quantity of the mercury reduced to the metallic state.

It was hoped, by means of this acid, to make the analysis of the salts of mercury by adding potash to these, in order to decompose them, at the same time that the phosphorous acid reduced the oxyde into running mercury. The results of trials made for this purpose proved however unsatisfactory. The mercurial salts that are decomposed by means of this alkali always retain some of it.

2. Of the grey oxyde of mercury.—Ten grammes of this oxyde, treated by phosphoric acid, yielded 9,25 of running mercury; whence it is concluded that this oxyde contains 7½ per cent. of oxygene. The oxyde was obtained by means of a solution of sulphate of mercury at the minimum, decomposed by ammonia, and boiling the precipitate.

3. Of the action of the phosphorous acid upon the salts of mercury.—By treating these salts in a direct manner with caustic potash, the following results were obtained: 1. The phosphorous acid in excess decomposes all the mercurial salts, reducing their oxydes into running mercury, and entirely separating their radicals. 2. When these salts are at the maximum of oxygenation, it reduces them to the minimum before it decomposes them. 3. The reduction of the mercury to the metallic state by this mean is complete. Should a phosphate be accidentally formed, it would immediately be decomposed by the phosphorous acid.

4. Of the analysis of the different mercurial salts.—As the phosphorous acid appeared, from the preceding experiments, to afford the best means of analyzing the mercurial salts, the following analyses were attempted.

Turbith mineral, very dry and well prepared, boiled with phosphorous acid till the mercury was reduced, and filtrated, gave: reduced mercury 7,7, equivalent to 8,47 of the red oxyde. The filtrated liquor, treated with muriate of barytes, gave 5 grammes of sulphate of barytes; which representing 1,5 of sulphuric acid, these contained a loss of 0,3, attributable to the moisture.

Neutral sulphate of mercury at the maximum, treated in the same manner by sulphurous acid, gave for its result: red oxyde 0,1, sulphuric acid 31,8, loss by moisture 4,4.

The supersulphated sulphate of mercury of commerce, treated by the

phosphorous acid gave: muriatic acid 18,6, oxyde of mercury at the maximum, 80,3, loss, attributed to the iron which is always found mixed with this salt as met with in commerce 1,1.

Nitrous turbith, nitrate of mercury at the maximum of oxygene and at the minimum of acid, treated with phosphorous acid, gave: oxyde of mercury at the maximum 88, nitric acid 12.

Phosphate of mercury at the maximum, treated in the same manner by the phosphorous acid, gave 6,5 running mercury, corresponding to 7,15 of oxyde of mercury at the maximum: the 2,85 wanting to complete the 10 grammes are attributed to the phosphoric acid.

This experiment proves that the phosphorous acid not only decomposes all the salts of mercury by different acids, but also those which are formed by the phosphoric acid.

Of the phosphites.—The phosphites likewise disoxygenate the oxydes of mercury, but their action is far inferior to that of the phosphorous acid; they also disoxygenate the mercurial salts, but their action is weaker.

Of the action of phosphorus upon the mercurial oxydes and salts.—On treating the red oxyde of mercury with phosphorus by means of water, at a gentle heat, a phosphuret of mercury is obtained, in which the phosphorus seems to exist in a state of feeble combination; by the same operation also some phosphoric acid is obtained. It appears that the phosphorus, which gives origin to this acid, attracts a portion of oxygene from the atmospheric air, and passes into the state of phosphorous acid, which is changed into phosphoric, in proportion as it takes oxygene from the red oxyde of mercury.

Phosphorus, placed in contact with red oxyde and water in the cold, first attracts oxygene from the red oxyde, and reduces it first of all into grey oxyde, and at length into the metallic state; but in this case no phosphorous acid, nor phosphoric acid, is formed; the phosphorus merely becomes oxydated and assumes a dark colour.

The mercurial salts are equally decomposed and deprived of their oxygene by phosphorus, with the application of heat as well as in the cold; but in the first case a phosphuret of mercury is formed, which consequently prevents its analysis by this means. Perhaps it might be accomplished in the cold; but the action is so slow, that any other more expeditious means would be preferable.

Of the action of the oxygenated muriatic acid upon the red oxyde.—On this subject nearly the same results were obtained as those formerly indicated by Messrs. Fourcroy and Thenard. The following experiments, however, exhibit some slight peculiarities which have escaped them.

Exp. I. Red oxyde of mercury was put into distilled water, and oxymuriatic acid gas made to pass into it, whereby a powder was precipitated; which, after washing and filtration, appeared of

and treating the liquor by sulphurated hydrogene, but very slight indications of the presence of mercury appeared. The residuum, washed and dried, gave nine grammes of mercury. Hence, it was concluded, that the red oxyde of mercury contains nearly $\frac{1}{10}$ by weight of oxygene.

This experiment shews a new mean of analyzing the mercurial oxydes, which seems preferable to sublimation, which is far less expeditious; and attended with the inconvenience of not giving with accuracy the quantity of the mercury reduced to the metallic state.

It was hoped, by means of this acid, to make the analysis of the salts of mercury, by adding potash to these, in order to decompose them, at the same time that the phosphorous acid reduced the oxyde into running mercury. The results of trials made for this purpose proved however unsatisfactory. The mercurial salts that are decomposed by means of this alkali always retain some of it.

2. *Of the grey oxyde of mercury.*—Ten grammes of this oxyde, treated by phosphoric acid, yielded 9,25 of running mercury; whence it is concluded that this oxyde contains $7\frac{1}{2}$ per cent. of oxygene. The oxyde was obtained by means of a solution of sulphate of mercury at the minimum, decomposed by ammonia, and boiling the precipitate.

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Neutral sulphate of mercury at the maximum, treated in the same manner by sulphurous acid, gave for its result: red oxyde 63,8, sulphuric acid 31,8, loss by moisture 4,4.

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Of the action of the oxygenated muriatic acid upon the red oxyde.—On this subject nearly the same results were obtained as those formerly indicated by Messrs. Fourcroy and Thenard. The following experiments, however, exhibit some slight peculiarities which have escaped them.

Exp. I. Red oxyde of mercury was put into distilled water, and oxymuriatic acid gas made to pass into it, whereby a powder was precipitated; which, after washing and filtration, appeared of

a deep violet colour. The evaporated liquor presented superoxygenated muriate of mercury in needles; the last liquor, after the crystallization, exhibited traces of another still more highly oxygenated salt, but in too small quantity to be subjected to experiment.

The violet powder, subjected to different experiments, gave the following results: 1. Boiled in water, it was found insoluble, and did not change its colour. 2. Treated with caustic potash, it was converted into red oxyde, and the liquor contained muriatic acid: there existed therefore in the powder a muriate of mercury. 3. To determine the nature of the latter and its proportion, 10 grammes of this powder were sublimed, which gave 2 of sublimed muriate and 8 of red oxyde not sublimed. The sublimed muriate dissolved almost entirely in muriatic acid, and the minute portion which did not dissolve was mild muriate.—Hence it appears, that the violet-coloured powder is not a simple oxyde of mercury, as has hitherto been supposed, but an oxygenated muriate of mercury, with a great excess of red oxyde of mercury, and that this excess of oxyde is combined with the salt.

Exp. II. From the above circumstances was concluded the possibility of forming a superoxygenated muriate of mercury, of a degree superior to that of corrosive sublimate.—Thirty grammes of red oxyde of mercury were therefore boiled with oxygenated muriatic acid, fresh quantities being added till no more absorption took place. The liquor was then decanted, and the powder washed and dried. The quantity of the latter was about the same as in the former experiment; with the same reagents it gave similar results, and yielded the same proportions by sublimation.—The liquor being evaporated, it yielded crystallized oxygenated muriate of mercury. The last portions of the liquor, evaporated to dryness, presented what was sought for, a superoxygenated muriate of mercury, possessing the following properties:

1. It is highly soluble and deliquescent; 2. Much more soluble in alkohol than ordinary oxygenated muriates; 3. It decrepitates with concentrated sulphuric acid, assumes a yellow colour, and evolves oxygenated muriatic oxyde gas; 4. The essential property, which no other salt besides this is known to possess, is, that, being mixed with the sulphuret of antimony, it inflames spontaneously at the ordinary temperature, some instants after the mixture is made. The residuum of this combustion, besides the sulphuric or sulphurous acids which are disengaged, consists of oxygenated muriate of mercury (corrosive sublimate) and muriate of antimony. This salt, however, possibly on account of its extreme deliquescence, does not decrepitate upon ignited coals, nor does it explode under the pressure of the hammer. The oxyde of mercury which is combined in this salt is of the same nature with that which is combined with the

oxygenated muriate: the alkalies likewise precipitate it in a yellow oxyde.

Conclusion from the last experiments.—The oxygenated muriatic acid produces, therefore, with the red oxyde of mercury, principally by the aid of heat, different kinds of salts, viz. 1. Muriate of mercury at the maximum, with a great excess of oxyde, resembling the turbith mineral as to its insolubility in water, but reducible by sublimation into oxygenated muriate of mercury and into red oxyde. 2. Simple muriate of mercury. This salt accompanies, in small quantity, the preceding salt. 3. Oxygenated muriate of mercury, which crystallizes by the evaporation of the liquor. 4. Superoxygenated muriate of mercury. This salt is extremely soluble and uncrystallizable.

Chemical Examination of the Bark of the White Willow and the Root of the Geum urbanum, compared with Peruvian Bark, and considered in a medical Point of View. By M. Bouillon-Lagrange.—*Ann. de Chim.* No. 162.

This inquiry was undertaken with a view to ascertain whether the two first indigenous vegetable substances were likely to afford fit substitutes for Peruvian bark (a substance which in France is sometimes hardly to be procured at any price). The principal results obtained were as follows:

The decoction of Peruvian bark precipitates glue, is decomposed by the alkaline carbonates; the solution of tartar emetic is rendered turbid by it, and the sulphate of iron forms with it a green precipitate.

The decoctions of white willow bark and of the root of the geum urbanum present the same phenomena, excepting that the geum throws down the sulphate of iron in a green precipitate.

The alcoholic tincture of Peruvian bark differs from those of the willow bark and the geum merely by its being of a higher colour.

The dry extract of Peruvian bark, prepared with water, appeared to present the same characters as those of the willow bark and geum; that of the willow bark, however, has less attraction for the atmospheric moisture.

The difference therefore appears to consist only in the Peruvian bark containing a somewhat larger proportion of resin, which varies according to the species of the bark and the method employed for obtaining this extract. What at present is called good bark in commerce differs very little from these two substances, and particularly from the root of the geum.

Hence it appears that these indigenous vegetables chiefly contain, as does the Peruvian bark, tannin, a colouring extractive matter, resin, and an acid, which seems to be a modification of

the gallic acid in the willow and Peruvian bark, but gallic acid in the root of the geum.

M. Bouillon-Lagrange conceives the root of the geum to possess chemical characters the most analogous to those of the Peruvian bark, and to be superior to the willow bark in its febrifuge properties.

On the Discovery of a new inflammable and detonating Substance, formed by the Action of the nitric Acid upon Indigo and the animal Matters. By Mess. FOURCROY *and* VAUQUELIN.—*Ann. de Chim.* No. 165.

THIS substance is formed by the ebullition of the nitric acid upon the azoted, animal, or vegetable substances. It is yellow, extremely bitter, and distinguished by its property of burning and detonating with violence by the aid of a moderate heat.

M. Hausmann appears to have seen this substance, but confounded it with the oxalic acid. Its principal property, that of inflammation and detonation, escaped his observation. The matter which Welter has termed the *bitter (Tamer)*, wherein he discovered the detonating property, but which he attributes to the presence of the nitrate of potash, appears to be the same substance.

The most convenient method of obtaining this substance is to boil four parts of nitric acid with one part of pulverized indigo, till its colour is destroyed, the acid has assumed a yellow hue, and there remains at the surface of the liquor only a thin layer of a resinous matter, which becomes fixed by cooling, and which must be separated; to evaporate the solution to the consistence of honey, to dissolve the residue in hot water, to filtrate, and to pour into the liquor a solution of potash, which forms in it small yellow crystals, of a circular form: this is the inflammable matter.

The resin which has been separated is converted by a new addition of nitric acid, into yellow detonating matter.

If we stop the operation before the period indicated, instead of the detonating matter, we obtain another yellow and crystalline substance, but which is more soluble in water, and sublimes in the form of white needles.

This substance presents all the properties of benzoic acid altered by resin. If the operation be continued, it is probable that the benzoic acid is decomposed or volatilized.

The authors have convinced themselves that the detonating property of their new-discovered substance was owing neither to the presence of nitric acid nor to that of ammoniac: they find more reason to believe that potash acts some part in this detonation; though its effect appears to be confined to rendering the

matter more fixed, favouring the accumulation of heat, and consequently determining the combustion of the elements that form it.

Indigo is not the only substance which furnishes the detonating matter: the muscular fibre, treated by the nitric acid, presents the same phenomena; and probably silk, wool, and other azoted animal and vegetable matters may yield it likewise.

Two interesting facts result from the experiments of Messrs. F. and V. viz. 1. That the benzoic acid can be formed from its constituent principles, which was hitherto not known; 2. That the azoted animal and vegetable substances, through the agency of the nitric acid, give rise to a substance supersaturated with oxygene, which gives it the detonating property. This substance appears to the discoverers to be a superoxygenated hydrocarburet of azote.

New Method of forging Platina. By Count MOUSSIN-POUSCHKIN *and M.* GEHLEN.—*Jour. de Chimie,* No. 17. Vol. vi.

THE platina is dissolved in nitro-muriatic acid.

The solution is concentrated to crystallization, the salt dissolved anew in water, and precipitated by ammoniac. The precipitate is washed with cold water and dried. When dry, it is put into a Hessian crucible, and reduced by a strong forging heat. After cooling, it is washed with a large quantity of hot water. The iron which remains combined with it is separated by boiling the matter in dilute muriatic acid, filtrating, washing, and heating it again to redness. One part of the platina thus treated is triturated with three parts of mercury, till a perfect amalgam is formed. This amalgam is put into wooden moulds, and the superabundant mercury pressed out: the amalgam is then placed together with the moulds, in the forging furnace, and heated to incandescence, whereby the wood is carbonized, and the mercury volatilized, whilst the platina retains the figure it had assumed in the mould. It is again brought to a strong red heat, and moistened, from time to time, with oil, which augments its malleability: after this, it is compressed, and when it has acquired the necessary solidity, beaten out.

M. Gehlen adds an observation of his own, which both confirms the Count's method, and furnishes the means of abridging his process. Wishing, on a former occasion, to procure pure platina, he precipitated, by an excess of mercury, a quantity of platina, dissolved in nitro-muriatic acid. He obtained a black precipitate, which, after washing and drying, presented a heavy powder, of little compactness, and no metallic lustre. This powder was brought, in a crucible, to incandescence, whereby the mercury was dissipated, and the matter shrunk to a fourth or

fifth of its former volume, and formed a coagulated mass of a metallic lustre, but having many cavities. The large pieces detached from the mass admitted of being beaten out by the hammer. M. G. thinks that if the black powder above mentioned were treated by the mechanical means prescribed by the Count, a more compact and more forgeable metal would be obtained, and the precipitation by sal ammoniac would be spared.

Chromate of Lead and Silver. By Count MOUSSIN-POUSCHKIN. —*Jour. de Chim.* No. 17. Vol. vi.

THE Count dissolved both the red lead spar and chromate of silver in nitric acid, by adding a little sugar at the moment the acid was poured on, and promoting the action by a moderate heat: the spar then requires only five or six parts of acid, and the chromate of silver not so much. Nitrous acid gas is disengaged, and the solution of the former has an amethyst colour; that of the latter a garnet red, without the least trace of green.

On Bile. By M. THENARD.—*Bulletin des Sciences,* No. 95.

BILE has been commonly considered as a saponaceous liquor charged with albumen, but, on closer examination, it has been found to present phenomena which cannot be accounted for merely by the presence of these principles. Bile, distilled to dryness, leaves a residuum equal to one eighth of its original weight, which contains only one fifth of soda, a portion of alkali not sufficient of itself to dissolve the quantity of oil which is known to exist in bile. This liquor may, therefore, be presumed to contain some other property to supply the absence of alkali. This is further confirmed by the action of acids upon bile. Acid mixed with bile, separates from it albumen, joined with a very small portion of oil. The liquor remaining after filtration is extremely bitter, and leaves, on evaporation, a residuum equal to what is obtained from a like quantity of bile in its original state. On dissolving the oil previously obtained from bile, in alkali, and adding a portion of albumen, a combination took place which was decomposed by the most feeble acids, and from which vinegar precipitated all the oil: this combination, therefore, was not bile; consequently bile consists not merely of albumen, oil, and soda, but must contain some matter peculiar to itself.

On pouring into bile acetite of lead, with a slight excess of oxyde, the whole of the albumen and oil were precipitated, and the liquor gave, by filtration and evaporation, a substance of a saccharine and acrid flavour, which, when pure, exhibits the following properties:

1. It is soluble in water and in alcohol, and slightly deliquescent.

2. It is not precipitated by common acetite of lead, but it is entirely by saturated acetite of lead; and this precipitate is soluble in acetite of soda.

3. It does not ferment with yeast, gives no ammoniac by distillation, and is not affected by the presence of galls.

4. With proper management, one part of it dissolves three fourths of the oily matter. As these matters are nearly in equal proportions in bile itself, it must be admitted that soda contributes to the complete solution of the oil; nevertheless acids affect it little, or not at all.

From the above experiments, and their results, the author concluded bile to be a triple compound of a little soda and much oily and saccharine matter; that acids decomposed it only in part; in other words, that it was capable of containing an excess of acid without having its portion of soda neutralized. On the calcination of bile that had been acidulated with sulphuric, muriatic, and other acids, the soda was always found left in the calx; it is, therefore, very probable that the saccharine matter, in conjunction with the oil, decomposed a certain quantity of marine salt, and destroyed the power of the acid. From a number of experiments, made in order to ascertain the proportions of the constituent parts of bile, the author concludes 800 parts of the bile of an ox to contain, water, 700 parts; oily matter, 43; substance peculiar to the bile, 41; animal substance, 4; soda, 4; marine salt, 3,2; sulphate of soda, 0,8; phosphate of soda, 2; phosphate of lime, 1,2; oxyde of iron, 0,5—799,7; 3 loss.

The author concludes his memoir with the following remarks: Bile forms an interesting subject for a number of other researches; the varieties to be found in the several species of animals, and which a multitude of circumstances, particularly a morbid affection of the organ which secretes it, may modify; the calculi which are there formed, and are of a peculiar nature; the oleaginous and animal substances; and that particular matter, differing from all others hitherto known, will no doubt excite a lively interest, and form the subject of several other papers which the author designs shortly to lay before the public.

Method of obtaining Cobalt pure. By M. TROMSDORF.—*Gehlen's Chem. Jour.*

ZAFFRE is detonated in a red-hot crucible, with charcoal and nitre. The resulting mass is mixed with black flux, and fused. The metallic cobalt is again detonated as before. The acid and arsenic are separated by lixiviation. The residue is treated with

nitric acid, which dissolves the cobalt without attacking the iron. The solution is then evaporated, the residue re-dissolved in nitric acid, and the liquor filtered, to separate the last portions of oxyde of iron.

On a Colour for marking the Ends of Cotton or Linen Cloths, capable of resisting the Operations of Bleaching and Printing. By M. Hauffmann.—*Ann. de Chim.* No. 158.

The properties required in a good marking colour are, that it contain no substance soluble in alkalies, that its component parts do not turn white by oxygenation, and that they remain insoluble in acids sufficiently strong for bleaching and the preparatory operations of calico-printing.

Oil colours are therefore improper for this purpose, because they yield to alkaline and saponaceous leys, and run in drying. Colours composed with spirit varnish are equally faulty, both on account of their too speedy evaporation and drying, and their easy conversion into soap. Copal is likewise unfit for marking, as it yields to boiling water. Varnish made from it is, however, useful for defending metal vessels against the action of the air and acids. To make a good copal varnish, dissolve the gum, with the aid of heat and agitation, in oil of turpentine. Dilute it for use with alcohol. Metallic vessels, after receiving two or three coatings of this varnish, may be exposed to boiling water, without injury.—By means of oil of turpentine, which evaporates and dries less speedily than alcohol, the author obtained a good black composition for marking cloths. It was made by dissolving slowly on the sand-bath, in oil of turpentine, one fourth of its weight of asphaltos, or bitumen of Judea, and afterwards mixing with it lamp-black, or any dark-coloured mineral in fine powder.

The following experiments were made on watery compounds.

Exp. 1. Sulphate of manganese is dissolved in water, the solution thickened with gum-dragon, and coloured with lamp-black. The impression being made with this compound, the cloth is plunged into alkaline ley, whereupon the manganese precipitates in brown oxyde, and affords a mark not to be obliterated by bleaching, or by the printing processes.

Exp. 2. The acetate of manganese cannot be used without subjecting it to the same treatment; and, as it is much more expensive, it ought to be rejected.

Exp. 3. Sulphate of manganese in solution with acetate of iron, and treated as before, furnishes a brown mark. The only advantage of the acetic solution is, that it causes the marks to dry a little more speedily.

Exp. 4. In the process of disengaging oxygene gas from a

mixture of the black oxyde of manganese and sulphuric acid, if care be taken not to carry the fire to ignition, a blackish saline residue is left, which yields, by washing, a dark grey oxyde. This oxyde, mixed with water and gum, affords, by simple impression, fixed and indelible marks.

Exp. 5. A mixture of the composition of *Exp.* 4, with a nitro-muriatic solution of tin, likewise affords an indelible colour, with the additional advantage of attracting, by its oxyde of tin, saturated with oxygene, the colouring parts of any dye, and turning dark brown with madder.

Exp. 6. From experiments with the precipitate of manganese and acetic solution of iron, it appeared that, in order to obtain from the mixture of these two metallic solutions an indelible marking colour, it was necessary to steep the marks for some minutes in an oxygenated muriatic alkaline ley, in order to saturate the oxyde of manganese with oxygene.

The muriatic solution of tin discolours and dissolves instantly the darkest oxydes of manganese and of iron.

The operation of steeping the marked goods in an alkaline ley may be performed without any perceptible loss of potash or of soda, especially if the practice of rendering the alkalies caustic with quick lime be adopted.

Examination of different Processes for parting Nickel and Cobalt. By M. Bucholz.—*Ann. de Chim.* No. 164.

M. Hermbstadt had proposed, for separating the oxyde of cobalt from the oxyde of nickel, a method which consisted in dissolving in ammoniac the nitrate or the sulphate of cobalt, impregnated with nickel, and exposing the solution to a single evaporation.

M. Bucholz tried this process, with some modifications of his own, and obtained the following results:

1. The sulphates and nitrates of ammoniacal nickel, extracted from the cobalt ore, always retain still cobalt in their composition; and it is impossible, according to the (modified) process of Hermbstadt, to obtain the oxyde of nickel without admixture of cobalt.

2. On partially decomposing the nitrate of ammoniacal cobalt by evaporation, an oxyde of nickel very rich in cobalt, and containing nitric acid, is obtained; and the oxyde of nickel which is found in this salt, not yet decomposed, contains a much smaller quantity of cobalt.

Dr. Schnaubert had indicated, in Tromsdorf's Journal of Pharmacy, a process for obtaining an oxyde of pure nickel, which consisted in dissolving the metal of nickel mixed with cobalt, or its oxyde already disengaged from the other sub-

stances, in nitric acid, precipitating it by carbonate of potash, and heating it to whiteness after the washing and desiccation. In this manner he always obtained (he says) a yellow oxyde, upon which he afterwards boiled pretty strong sulphuric acid, which gave him a solution of nickel of a grass green colour; whilst the oxyde of cobalt presented itself as a residuum of a yellow colour. He proved the purity of the sulphate of nickel prepared in this manner, by the property which ammoniac possesses of precipitating it of a light green, and, added in excess, of redissolving it with a fine dark-blue colour.

M. Bucholz's experiments on this process proved:

1. That the oxyde of nickel, heated gently or violently, does not assume the yellow colour; and that, if this colour has been observed by Dr. Schnaubert, it must have depended either upon a certain proportion of the elements which entered into the composition of the oxyde, or perhaps upon the admixture of a small quantity of arsenic.

2. That we cannot, by means of Dr. S.'s process, obtain an oxyde of nickel exempt from cobalt, as it does not even effect a parting of the two oxydes sufficiently complete to be sensible to the eye.

Of the Carbonate of Potash. By M. Steinacher. *Ann. de Chim.* No. 163.

Carbonate of potash, well saturated so as to effloresce, can be formed only by causing to pass through a cold alkaline solution a quantity of carbonic acid, sufficient to cause a spontaneous crystallization.

All the methods hitherto recommended for this purpose are either insufficient or inconvenient; the following improvement on Pelletier's apparatus is therefore recommended.

Put a kilogramme of powdered chalk into a bottle with two or three tubulatures, capable of containing 12 kilogrammes of water; upon this pour a mixture of $1\frac{1}{2}$ kilogramme of sulphuric acid with 9 kilogrammes of spring water. The gas is expelled, and a crust of sulphate is formed at the surface of the calcareous carbonate. At the end of two hours add all the rest of the acid water at once, and stop the bottle immediately. Bubbles of air will be rapidly disengaged, but their evolution will gradually abate and continue in moderation for 24 hours; the mixture must then be stirred with an iron rod, and the gas will continue to be developed for 24 hours longer with little interruption.

The author concludes with the following observations:

Pelletier was wrong in neglecting to use an intermediate bottle half filled with water, which is necessary to separate the sulphuric acid which the gas always carries over.

In the place of the tubes of an inch diameter, which are too

difficult to be bent, we may substitute others of seven or eight lines aperture, which succeed equally well.

The alkaline solution made in the proportion of 2 libs. of alkali to 3 libs. of water, crystallizes too quick, and before the complete precipitation of the silex.

The proportions of alkali and water most favourable to a regular crystallization, at the temperature of from 5 to 10 Reaum. are one part of distilled water, and half a part of purified potash.

Experiments on Gum Arabic and Gum Adracanth. By M. VAUQUELIN.—*Ann. de Chim.* No. 162.

RED gum adracanth produced on combustion 3½ hundredths of ashes, composed chiefly of carbonate of lime, a small quantity of iron and phosphate of lime, with perhaps a very minute portion of alkali.

White gum adracanth left 3 hundredths of ashes, containing the same principles as the former, with the addition of a little potash.

Gum arabic left three hundredths of ashes, composed of the same elements as the preceding, except that they shewed no sign of alkali, or of sulphur.

Hence it appears, that the opacity of gum adracanth, and its difficult solution in water, are occasioned by another cause than a larger proportion of earthy matter.

The lime in gum is united to an acid forming soluble salt: this acid must be either the acetous or the malic, which are the most abundant in the vegetable kingdom; but as the malic forms insoluble compounds with lime, it is more probable that this earth in the vegetable juices is combined with the acetous. The potash in gums is also probably united to the same acid. However, in certain opake adracanth gums of difficult solution, and which yield much lime on incineration, this earth is probably combined with malic acid.

From the above experiments it results, that the gums contain; 1. a calcareous salt, most commonly acetate of lime; 2. sometimes a malate of lime with excess of acid; 3. phosphate of lime; 4. some iron, probably also combined with phosphoric acid.

Experiments on a Mineral formerly called false Tungstein, now Cerite, in which a new Metal has been discovered.—(From a Paper by VAUQUELIN *in the Annales de Chimie,* No. 160, *and another by Mess.* HISINGER *and* BERZELIUS, *in the Journal de Chemie.* No. 17. Vol. vi.)

M. KLAPROTH wrote to M. Vauquelin, that he had discovered in the tungstein of Bastnas a new earth, to which he gave the

name of ochroite, on account of the red colour which it acquired by calcination. Mess. Hisinger and Berzelius, hearing this, wrote to M. V. claiming the priority of discovery; but at the same time affirming, that what they had found was a new metal. They afterwards sent M. V. specimens of the mineral, which he analyzed. The following are the results of his analysis:

The pure cerite is semi-transparent, with a slight rosy tinge: it scratches glass, strikes fire with difficulty: its specific gravity is 4,530: its fracture compact and a little shining: its powder is greyish, and becomes yellow by calcination; losing 12 per cent. (According to Mess. H. and B. it is opake, and sometimes, though rarely, yellowish; it does not scratch glass; its fracture is unequal and angular, and it loses 6 or 7 per cent. in calcination.)

Exp. 1. Two hundred parts of the mineral heated three times successively with nitro-muriatic acid, gave much nitrous acid and oxymuriatic acid gas. The first and second solutions, diluted with water, were gold-coloured, the third colourless. The two former, mixed together, deposited a white sediment. The residuum left by the nitro-muriatic acid was grey, with a slight reddish tinge, and weighed 62, consequently 138 parts were dissolved.

Exp. 2. The solutions being evaporated to the consistence of syrup, to volatilize the superfluous acid, remained clear to the end of the operation. Their residuum, diluted with water, gave a milky liquor, of a reddish tint and very astringent. Prussiate of potash produced in it a greenish blue precipitate, which was changed into brown by a little ammonia. All the liquor, into which a small quantity of ammonia had been put to precipitate the iron, alone, was poured into a filter, but would not pass. It was therefore heated and filtered, when it exhibited a gold colour and a saccharine taste. Prussiate of potash and oxalate of ammonia threw down from it white precipitates. The matter left on the filter was of a red colour, like oxyde of iron at the *maximum*.

The solution thus deprived of the red matter was examined. Prussiate of potash gave with it a white, flakey, gelatinous precipitate; infusion of galls, a brown, flakey sediment, not affected by muriatic acid; carbonate of potash, a copious white gelatinous precipitate; caustic potash, the same; oxalate of ammonia, a similar one, insoluble in an excess of oxalic acid; sulphuric acid, a yellow crystalline precipitate soluble in water: muriate of tin whitened the solution, without forming any precipitate.

Exp. 3. The solution was evaporated; it became turbid, and formed an abundant flesh-coloured deposit: this was treated with acidulous oxalate of potash, to dissolve the iron, without success; the addition of nitric acid was equally unsuccessful; muriatic acid gas added to the preceding dissolved the precipitate with effervescence and emission of oxymuriatic acid gas. A

white crystalline substance however remained, consisting of oxyde of cerium with oxalic acid. The greater part of the excess of acid in the solution being saturated with ammonia, oxalate of ammonia was added till no more precipitate was formed. This precipitate had all the properties of oxalate of cerium. Ammonia threw down from the filtered liquor oxyde of iron.

Exp. 4. The matter precipitated from the solution of cerium by ammoniac in Exp. 2, dissolved in muriatic acid with effervescence and disengagement of oxymuriatic acid gas. Oxalate of ammoniac precipitated from this solution oxyde of cerium, and the filtered liquor gave with ammoniac a red precipitate, which was oxyde of iron tolerably pure.

Exp. 5. The liquor, freed from the greater part of the iron by ammoniac and heat, which had notwithstanding a slight rosy tinge, was precipitated by oxalate of ammoniac. The precipitate, at the moment of its formation, had the appearance of muriate of silver, but soon became granulous, and was deposited in this form. The liquor passed through the filter colourless, and the rosy tinge which it had, remained in the oxalate.

Exp. 6. As the liquor from which the oxalate of cerium was precipitated contained an excess of acid, it might be presumed to hold in solution most of the oxalate of lime formed at the same time with the oxalate of cerium, if this metal contained any lime, as this salt is soluble in nitric acid. Accordingly, the liquor and the water which had washed the precipitate being mixed and concentrated by evaporation, they yielded, on the addition of ammoniac, a small quantity of oxalate of lime.

Exp. 7. However, as it was possible that some oxalate of lime might have been precipitated with the oxalate of cerium, a portion of the red oxyde of cerium arising from the decomposition of the oxalate by calcination was dissolved in muriatic acid. A brisk effervescence immediately took place, with a disengagement of oxymuriatic gas, which continued till the whole was dissolved, and differed in no respect from that prepared with oxyde of manganese.

The solution of cerium in muriatic acid was clear, and had only a light rosy tinge. To separate it from the lime, if it contained any, ammoniac was added; when the solution, having been diluted with but a small quantity of water, concreted into a semi-transparent gelatinous mass, so solid that it could not be got out of the bottle till after it had been agitated with a great deal of water.

This matter, being washed and calcined, was very compact, and had a brilliant fracture.

The liquor thus decomposed by ammoniac, being mixed with oxalate of ammoniac, gave a precipitate which yielded quicklime by calcination.

At the moment when the oxyde of cerium is precipitated by

ammoniac, it is white and semi-transparent; but by agitation in the air and drying, it becomes yellowish and opake. This does not proceed from the combination of the alkalies with the cerium; for when it has been well washed, no traces of them can be discovered by the most careful analysis.

The residuum left after the action of the acids was next examined, when it appeared that the purest ores of cerium from Bastnas contained:

1. Oxyde of cerium -	63
2. Silex - - -	17,5
3. Oxyde of iron - -	2
4. Lime - -	3 to 4
5. Water - - -	12
	98,5

(Mess. H. and B. say, Silex 23 parts, carbonate of lime 5,5, oxyde of iron 22, and oxyde of cerium, after calcination, more than 50. The increase of weight they attribute to oxygene absorbed by the iron and the cerium.)

M. Vauquelin analyzed also other specimens which were mixed with green actinote and cupreous pyrites; but as nothing particular occurred in these analyses, it is unnecessary to enter into them.

Cerium, like several other metals, appears to be susceptible of two very distinct degrees of oxygenation; that which contains the least oxygene is white, and that which is saturated is fallow-red. Though these two oxydes differ considerably in many respects, their quantities of oxygene are not very dissimilar, where they can very readily be commuted into each other.

The oxyde at the *minimum*, exposed to the blow-pipe, soon becomes red, but does not melt, nor even agglutinate. Borax determines its fusion; if we take only a small quantity of oxyde, it melts into a transparent yellow globule; but if the borax is supersaturated with it, the globule becomes opake as it cools. On gently heating a transparent compound of borax and oxyde of cerium, it becomes milky like a tin enamel.

(According to Mess. H. and B. it becomes, when fused with borax, first blood-red, then, as the heat decreases, green, yellowish, and at last colourless. If kept in the middle of the flame, it continues as clear and colourless as glass. These phenomena are more evident, if a phosphoric salt be employed. If two colourless globules, one formed with borax, the other with a phosphoric salt, be fused together, a transparent compound is produced, which in cooling becomes opake and pearl-coloured.)

The oxyde of cerium at the *minimum*, precipitated from a muriatic solution that has boiled for a long time, is as white as

oxyde of tin; but it soon becomes yellowish in the open air, but never so red as by calcination, because it readily combines with carbonic acid, which opposes its union with oxygene to the point of saturation, and because it always retains a portion of water, which diminishes its colour.

Caustic potash produces no action upon the oxyde of cerium at the *maximum* in the cold; but with the aid of heat it deprives it of its red colour, and renders it white. If we dry the mixture, and urge it to fusion, it becomes red again. Alkalies appear to exert no other action upon it.

Sulphuric acid dissolves the oxyde at the *maximum* with great difficulty. Equal parts of it, and of sulphuric acid diluted with four times its weight of water, combine readily when heated, without the oxyde dissolving; and the whole mass assumes a crystalline form and a brilliant aspect. On adding fresh acid, and heating the mixture a long time, a complete solution takes place. This solution, evaporated by a gentle heat, crystallizes in very small needles, some of which are of an orange, others of a lemon colour. (The first of these Mess. H. and B. consider as sulphate of cerium at the *maximum*, the second as sulphate at the *minimum*). If the solution be evaporated quickly, nothing but a yellow powder is obtained. The sulphate of cerium is soluble in water only by means of an excess of acid. Its taste is saccharine and acid.

Sulphuric acid combines easily with the oxyde of cerium at the *minimum*, particularly when it is in the state of carbonate. The solution is colourless, or at least has only a slight rosy tinge; its taste is saccharine without any sensible acidity, and it readily affords white crystals.

Nitric acid does not easily dissolve the red oxyde of cerium, unless assisted by heat. If the acid be superabundant, the solution yields white deliquescent crystals; if the combination be neutral, it does not crystallize, but yields a yellowish salt by desiccation, of which alcohol, at 30 degrees, dissolves half its weight. The nitrate of cerium is decomposed by heat, and leaves a brick-coloured oxyde.

The oxyde at the *minimum* unites more easily with nitric acid; but this salt is not more easily crystallizable. Its taste is at first pungent, afterwards highly saccharine.

Muriatic acid dissolves the red oxyde with effervescence, and a considerable disengagement of oxymuriatic acid gas. This solution crystallizes in a confused manner. The salt is deliquescent, soluble in an equal weight of cold water, and in three or four times its weight of alcohol. The flame of this solution acquires no colour from the salt; but, if agitated, white, red, and purple points appear in it. (When this solution is concentrated, it burns with a yellow sparkling flame. Mess. H. and B.)

Oxymuriatic acid has no action upon the oxyde of cerium at the *maximum*; but it dissolves the oxyde at the *minimum* without yielding to it any of its oxygene.

The oxyde of cerium unites easily with carbonic acid. The best method of forming this compound is to decompose a solution of the nitrate or muriate of the white oxyde by saturated carbonate of potash, when a very white precipitate will be formed with effervescence, which is very light, and on drying assumes a shining silvery appearance.

Sulphurated hydrogene does not combine with oxyde of cerium; but the hydrosulphurets may be employed for purifying cerium of any iron that it may contain; for when this is the case, the first portions of hydrosulphuret will throw down from its solutions a greenish precipitate till no more iron remains.

The oxyde of cerium at the *minimum* unites directly with tartarous acid, but it requires an excess of the acid to render the combination soluble.

Mess. H. and B. have observed, as well as M. V. that, if the salts of cerium, decomposed by tartrite of potash, still contain traces of iron, the iron remains dissolved in the liquor, particularly if a slight excess of tartrite be employed. They have, therefore, proposed this method as the best for freeing the cerium from iron. The process they recommend for obtaining pure oxyde of cerium is, to dissolve in nitro-muriatic acid any quantity of cerite, carefully selected and thoroughly calcined; to filter the solution, neutralize it by caustic potash, and then precipitate by tartrite and potash. The precipitate well washed, and afterwards calcined, is pure oxyde of cerium.

M. Vauquelin made several unsuccessful attempts to reduce this metal. However, having mixed tartrite of cerium with a very small quantity of oil and lamp-black, he put it into a crucible of charcoal bedded in sand within an earthen crucible, and heated it for an hour and a half in a forge furnace. A metallic globule, scarcely as large as a pin's head, was now left in the coal; but no other trace of cerium could be discovered, although the sand was examined with the utmost care.

None of the simple acids acted on this globule, but it dissolved, though with extreme difficulty, in the nitro-muriatic, after being triturated. The solution was reddish, and exhibited unequivocal signs of the presence of iron; but it likewise gave evident marks of the existence of cerium, both by its saccharine taste, and by the white precipitates which tartrite of potash and oxalate of ammoniac produced in it. The metallic globule was also more brittle, harder, more lamellated in its fracture, and whiter than pure cast iron.

As, from these experiments, cerium appears to be volatile, a similar mixture, with the addition of borax, was heated in a porcelain retort, to the neck of which a porcelain tube was adapted.

Whether, however, from the insufficiency of the heat, or from the metal being volatilized without adhering to the neck of the retort, no trace of sublimate was found; but several very small metallic globules remained in the retort, adhering to a black varnish formed by the borax. Some of these globules were found about the upper part of the vessel, to which they had apparently been sublimed by the force of the fire; but all these globules together would not have amounted to $\frac{1}{50}$ part of the cerium employed.

M. Vauquelin concludes his memoir with the following general summary of the properties of cerium:

1. It is susceptible of forming two species of oxydes, the one at the minimum, white, uniting readily with all the acids, and forming white combinations with a slight rosy tinge: the other, reddish, dissolving with greater difficulty in the acids, giving coloured combinations, more acid and less crystallizable than those of the oxyde at the minimum, and produced by the oxymuriatic acid with the muriatic acid.

2. These oxydes form with the acids two kinds of salts considered with regard to their solubility; soluble and saccharine ones with the nitric, muriatic, and acetic acids; insoluble and insipid ones with the phosphoric, acetic, tartarous, prussic, and carbonic acids.

3. These oxydes communicate to vitrifiable mixtures, and particularly to borax, a yellow colour and opacity, if they are in a superabundant proportion.

4. They are difficult of reduction by the ordinary means, and the metal seems to be volatile.

5. They do not unite with sulphur or with sulphurated hydrogene, a property which they possess in common with some other newly discovered metals.

6. Cerium is a peculiar metal differing from all others hitherto known, and not an earth.

On Niccolanum, a newly discovered metallic Substance; in many Respects resembling Nickel. By Dr. RICHTER.—*Ann. de Chim.* No. 162.

DR. Richter had long suspected that the cobalt ores of Saxony contained, besides cobalt, arsenic, copper, nickel, and iron, some other metallic substance which resembled nickel in many of its properties; because the nickel, after having been purified by the liquid process, and then reduced without the addition of a combustible body, never formed a perfect metallic button, but was always in tubercles.

He took half a pound of oxyde of nickel, purified as well as possible by the liquid process. The operation had lasted upwards

of a year, and yet the oxyde was not of a lively green colour. On attempting to reduce this oxyde *per se*, he obtained only a small quantity of pure nickel in a mass. He then pulverized the accompanying matter, and separated the nickel by the magnet and the nitric acid. This matter, exposed to reduction *per se*, yielded no more regulus.

He then mixed this matter with charcoal, and exposed it to the heat of a porcelain furnace during eighteen hours. After having broken the crucible, he found a well-fused metallic button. This metal was different from nickel. It had a grey steel colour inclining to red; it was rather hard, slightly malleable, attractable by the magnet, but less so than nickel. It had many properties common to nickel, but was entirely distinct from it in others. He therefore termed it *niccolanum*.

The specific gravity of cast niccolanum is 8,55, and of forged 8,60. Nitric acid dissolves it more quickly than nickel. This blackish green solution, evaporated to dryness, leaves a black residue. With muriatic acid it forms a green solution, which, evaporated to dryness, produces a reddish mass, that turns green in moist air. The dark-coloured oxyde of nickel is insoluble in nitric and in sulphuric acid; but when sugar or alcohol is added, the solution takes place with ease at the boiling point. The sulphate of niccolanum combined with water is blackish green, but becomes pale red when deprived of the water. If carbonate of potash be added to any of the above-mentioned solutions of niccolanum, it occasions a precipitate of blue carbonate of niccolanum. If the solution of niccolanum is decomposed by caustic potash, it gives a precipitate of a deep greenish blue. If ammoniac is added in excess to its solutions, the liquor assumes a pomegranate red colour, and remains transparent.

Niccolanum resembles cobalt, 1. by its property of supersaturating itself with oxygene at the expense of the nitric acid, and thus forming a body resembling the black oxyde of manganese with regard to its solubility in the acids: 2. by its property of not being reducible without the aid of a combustible body. It differs from cobalt, 1. by the blackish green colour of its solutions, even when entirely neutralized; 2. by the colour of its carbonate, which is of a blueish green; 3. by the colour of its oxyde precipitated without carbonic acid, which is a greenish blue.—Niccolanum resembles nickel, 1. by its strong magnetic quality; 2. by its malleability; 3. by the deep green colour of its solutions; 4. by the loss of this green colour when its neutral combinations are deprived of water; 5. by the colour of the acid solution with an excess of ammoniac. Niccolanum differs from nickel, 1. by its not being capable of reduction without the aid of a combustible body; 2. by its being more easily attacked and oxydated by nitric acid; 3. by its manner of supersaturating itself with oxygene at the expense of the nitric acid; 4. by the reddish colour of its

combinations with the acids when deprived of water; 5. by the blueish green colour of its carbonate, and of its oxyde precipitated without carbonic acid.

Analysis of the grey Epidote of the Valais in Switzerland.—By M. LAUGIER.—*Jour. de Phys.*

THIS mineral, which Delametherie terms *thallite*, and Haüy *epidote*, varies in its colour. Though this substance is generally of a green colour, this variety is of an ash-grey. It is found in the Valais. We had already the analysis of two varieties of thallite. Descotels had analyzed that of Dauphiny, and Vauquelin that of Arendal in Norway. Laugier has now analyzed that of the Valais. The three analyses give the following results:

The epidote of the Valais, as analyzed by Laugier, contains: silex, 37,0; alumine, 26,6; lime, 20,0; oxydated iron, 13,0; oxydated manganese, 0,6; water, 1,8; loss, 1,0. That of Arendal, as analyzed by Vauquelin: silex, 37.; alumine, 21.; lime, 15.; oxydated iron, 24.; oxydated manganese, 1,5; loss, 1,5. The epidote of Dauphiny, analyzed by Descotels: silex, 37.; alumine, 27.; lime, 14.; oxydated iron, 17.; oxydated manganese, 1,5; water and loss, 3,5.

Analysis of the Amphibole of the Cape of Cadiz. By M. LAUGIER. —*Jour. de Phys.*

THIS mineral is found among the volcanic products of the cape of Cadiz in Spain. Several mineralogists have called it black schorl. Those of Germany rank it among the numerous substances which they term hornblende: Haüy calls it amphibole.

It appears to have great similarity to the *strahlstein* of the Germans, or the actinote.

Lampadius has analyzed a species of hornblende, from which he asserts that he has extracted a considerable quantity of carbone. Laugier has found none in that of Cadiz. The following are the products which he obtained from the latter: silex, 42; oxydated iron, 22,69; magnesia, 10,90; lime, 9,80; alumine, 7,69; oxydated manganese, 1,15; water and loss, 5,75. The analysis of the strahlstein gives: silex, 50; oxydated iron, 11; magnesia, 19,25; lime, 9,75; alumine, 0,77; oxydated manganese, 0,50; chrome, 3.; potash, 0,50; water and loss, 5,25.

Notwithstanding the differences which these results present, Laugier draws the following inference from them: "The result of this comparative analysis seems to establish such a similarity between the actinote and the amphibole, that it appears necessary to consider them as the same species of stone, as modern mineralogy had already indicated."

Analysis of the Ichthyophthalmite. By Messrs. FOURCROY *and* VAUQUELIN.—*Jour. de Phys.*

DARANDA, a mineralogist of Brazil, has given the name of ichthyophthalmite to a stone, the colours of which have a play resembling that of the eyes of fishes.

It is white, transparent, with a small opaline eye. It divides into laminæ, which possess a certain degree of flexibility. Its specific weight is 2370. It forms a jelly in the acids. Small masses of carbonate of lime and some grains of oxyde of iron are found attached to the laminæ of the ichthyophthalmite, or interposed between their interstices.

The analysis of this stone gives: silex, 51; lime, 28; water, 17; potash, 4.

On the Preparation of sulphuric Ether. By Messrs. HENRY *and* VALLE'E.—*Ann. de Chim.*

FOR obtaining from a given quantity of alcohol the greatest possible quantity of ether, Messrs. Henry and Vallée found that indicated by all chemists to be the best; namely, equal weights of alcohol and sulphuric acid.

The white vapours which appear in the receivers, during the distillation of the ether, and which indicate that the operation ought to be stopped, are not formed, as has hitherto been believed, by sulphurous acid, but by oil and water in a state of expansion, which always accompany this acid; so that the product, whatever care be taken in the distillation, contains not only sulphurous acid, but also oil, which colours it more or less in proportion to its quantity. If, after having drawn off the first product, the distillation be continued, the white vapours augment, much water passes over into the receivers; this water is found covered by a liquid of a lemon colour and of a strong suffocating smell; this is what is known by the name of etherated oil. This oil is nothing else than ether, more or less charged with sulphurous acid, and bituminous oil which has much resemblance to the petroleums. Its composition was ascertained by an easy and accurate analysis. After having mixed with it an alcoholic solution of potash it was distilled, and more than $\frac{5}{6}$ of very pure ether, marking 55° by the aerometer, was obtained: there remained in the retort a sulphite of potash, and an oil saporified by the caustic alkali which was in excess. The alkali was saturated by sulphuric acid diluted with water, and at the top was soon seen to float an oil of a gold colour and unctuous to the touch; of a taste which at first seemed sweet, but afterwards

became acrid and very permanent; of a bituminous and amber-like smell, little volatile in this state, not miscible with water, soluble in alcohol and in ether, inflammable by concentrated nitric acid, susceptible of combining anew with caustic alkalies, and of again forming a soap.

The presence of this oil having been fully proved in ether distilled in the most careful manner, Messrs. Henry and Vallée conceive that most of the means indicated for rectifying it are insufficient. Caustic potash and soda merit the preference for rectifying ether; and in order to prevent their becoming carbonated, a solution of these alkalies in alcohol must be employed: by this means the disengagement of the carbonic acid gas is avoided, which always carries along with it a large quantity of ether; the sulphurous acid is neutralized at the same time that more fixity is given to the oil by saponifying it, and by a single rectification a very fine ether is obtained free from all that after-flavour which proceeds merely from the oil retained in it.

New Method of preparing Cerus in the large Way.—Jour. de Chim. No. 17, Vol. vi.

Take any quantity of lead-ashes, and dissolve them with the aid of a mild heat, in a sufficient quantity of dilute nitric acid. Filtrate the solution, and precipitate by chalk. The precipitate washed and dried, gives very pure and beautiful cerus.

Galvanic Experiments. By M. Ritter.—*Jour. de Chim.* No. 17, Vol. vi.

M. Ritter took a glass tube 6 inches long, and from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch diameter, of which a third or fourth was filled with mercury, and the rest with water. A thick iron wire was passed into the tube at each end; the tube was placed in an inclined position, its upper wire was made to communicate with the positive pole, and its lower with the negative. After some hours the mercury was found covered with oxyde of iron of a beautiful indigo-blue colour.

Another interesting product obtained by M. Ritter is, the superoxydated oxyde of silver This oxyde is formed in any solution of silver, at the end of the positive gold wire of the pile: it has a perfect metallic lustre, conducts electricity and galvanism very well, and has the appearance of galene of iron. The superoxydated oxyde of silver, reduced to powder and thrown into common muriatic acid, produces, even cold, a strong effervescence with an abundant disengagement of oxymuriatic gas, and is at the same instant converted into *luna cornea*.

The brown oxyde of lead may be obtained in the same manner. It has a fine metallic lustre, conducts electricity well, exhales oxygenated muriatic acid vapours with the muriatic acid, like the superoxydated oxyde of silver, but not in such large quantities.

As silver may be superoxydated, so it may also be hydrogenated by the pile. Hydrogenated silver is obtained by decomposing by the negative gold or silver wire of the pile, a solution of silver sufficiently dilute for the hydrogene disengaged to be in larger quantity than is requisite for disoxydating the silver. The excess of hydrogene combines with the metal, and forms a compound, which is deposited in the form of a black incrustation, of a spongy body, or a beautiful dendrites, and which is true hydrogenated silver. This substance was known to Priestley, who termed it dephlogisticated silver. M. Bucholz, who also obtained it, considered it to be silver imperfectly reduced. By the action of heat, however, the hydrogene may be disengaged from it, after which there is left reduced silver. Copper and tin are likewise susceptible of the same hydrogenation.

Chemico-galvanic Observations.—By M. Oersted.—*Jour. de Chim.* No. 17, Vol. vi.

M. Ritter having formerly observed that the conducting wires of a pile, held in the flame of a candle, became covered with figures of grease, which on the negative wire assumed the form of a vegetation, and upon the positive wire a different form; M. Oersted wished to ascertain whether every galvanic oxydation were accompanied with a similar phenomenon, and for this purpose made the following experiment. He placed the two poles of the pile, in communication with two solutions of acetate of lead. On the positive side, the oxyde of lead was thrown down in a brown precipitate; on the negative side it was reduced. The oxyde assumed a form similar to the figures of grease at the positive pole, and the reduced metal formed a fine vegetation. The oxyde resembled in form the roots of plants.

M. Ritter had likewise remarked, in the course of his experiments upon the commotion which mercury experiences from the discharge of the pile, that this metal became less liquid on the positive side, and more liquid on the negative. This experiment M. Oersted repeated with the same result. He likewise performed the experiment with an amalgam of lead, which was kept fused under hot water. On letting the water cool in communication with the poles of the pile, he remarked that towards the positive pole the amalgam became solid more speedily than towards the negative pole.

Acidulation of the Sulphate of Potash.—By M. Oersted.—*Jour. de Chim.* No. 17, Vol. vi.

M. Oersted being engaged in a series of experiments upon the insipid sulphurous acid of Winterl, obtained, with sulphurous acid prepared according to the process of Fourcroy and Vauquelin, instead of a neutral sulphate, an *acidulous* one, which reddened vegetable blues and effervesced with acids. The neutral combinations was hardly crystallizable. The sulphate of potash was not transformed into sulphate, but there was formed a triple salt composed of sulphuric acid, sulphurous acid, and potash. This salt crystallizes in sextangular prisms; it is less soluble in water than the sulphite of potash, but more so than the sulphate of the same alkali; and when treated with a more powerful acid, it exhales an odour of sulphurous acid gas.

Muriatic Solution of Tin, in Part decomposed into crystallized metallic Tin. By M. Bucholz.—*Jour. de Chim.* No. 17, Vol. vi.

With a view to prepare the muriate of tin, M. B. heated 7 lbs. of the finest English tin, with 15 lbs. of muriatic acid, of 1,120 sp. gravity. At the close of the evening there remained still from 2 to 2½ lbs. of tin to be dissolved. On the following day, the matter was still warm, and the liquor had the consistence of a syrup. He gently poured upon it a pound of water, which swam above the solution. At the end of an hour, on examining this mixture, he was surprised to find that the undissolved tin, and particularly its projecting parts, were covered with points, needles, laminæ, &c. of crystallized metallic tin, from ¼ to ½ an inch in length.

On repeating the same operation some time after, M. B. had the satisfaction to see the same phenomenon reproduced. He convinced himself by all possible trials that the tin which he had employed was perfectly pure.

Report made by Messrs. Boullay and Planche, on a new Process for the Preparation of the Muriate of Barytes, and on the Means of depriving the distilled Spirits prepared from Potatoes, Hops, &c. of their disagreeable Odour. By M. Resat.—*Ann. de Chim.* No. 163.

M. Resat had written a letter to M. Parmentier, containing, among other observations, a new process for preparing the muriate of barytes, and a method of depriving the spirits distilled

from potatoes, hops, and other substances, of their disagreeable odour, by the addition of a small quantity of sulphuric acid, and a new distillation. This letter M. Parmentier communicated to the Society of Pharmacy at Paris, who commissioned Messrs. Boullay and Planche to repeat M. Resat's experiments, and report to them upon them.

Of the muriate of barytes.—The process which M. Resat mentions as having succeeded best with him in preparing this salt, he describes by directing to take pulverized sulphate of barytes, 4 parts; charcoal, likewise pulverized, one part; flowers of sulphur, $\frac{1}{3}$ part. It requires, he says, less than half the time required by the known processes, and more than a twelfth part more of crystals are obtained from the first crystallization. He gives no details respecting the mode of operating, the quantity of salt obtained by the processes already known, the duration of his process, &c. Messrs. Boullay and Planche thought it necessary therefore to repeat, for the sake of comparison, the process which has long been in use in the laboratories, that of M. Bouillon-Lagrange, and that of M. Resat.

The quantities of muriate of barytes obtained by the three processes, for each of which 16 ounces of sulphate of barytes were employed, were found to be as follows:

1. Old process - 4 ounces 6 drams.
2. M. Bouillon-Lagrange's process - 5 - 1 - 40 grains.
3. M. Resat's process 7 - - - 12

The reporters sum up the result of their investigation on this subject in the following reflections.

1. The process of M. Resat has this advantage over the old one, that it furnishes a greater quantity of muriate of barytes which can be obtained pure after the first crystallization. 2. If it were possible to burn the large quantity of sulphurated hydrogene gas which is disengaged during the operation, there is no doubt that the new process would obtain the exclusive preference. These reflections will more particularly interest pharmaceutical practitioners, who, under the constraint of local circumstances, cannot attempt operations of this kind, without incurring some danger to themselves, and exposing themselves to the reproaches of their neighbours, who are incommoded by the offensive odours. Such will not hesitate to give the preference to the process of Bouillon-Lagrange which possesses the advantages of security to the operator, celerity of the operation, saving of fuel, and the means of applying to an useful purpose a salt (muriate of lime) which almost always abounds in the laboratories.

Of the Means of depriving distilled Spirits of their disagreeable Odour, particularly those prepared from Potatoes and Hops.

M. Resat describes his process thus: "Into 50 kilogrammes of ill-tasted spirit I poured 5 hectogrammes of sulphuric acid: after having stirred them together, I let them stand for twenty-four hours, and then distilled. The spirit was without any perceptible smell of ether; the acid had oxydated the oil to such a degree as to render it fixed."

With a view to repeat this process, Messrs. B. and P. endeavoured to procure a quantity of spirit distilled from potatoes and hops. Not being able to obtain any such, they took some bad brandy *(eau de vie de marcs)*, which they treated according to M. R.'s method. The liquor which they obtained in this manner had the following properties: 1. Its smell and taste were much less disagreeable than previous to distillation; 2. Mixed with a third of its volume of pure water, the original odour appeared again in almost the same degree as before, though the bad taste was sensibly improved.

Although they cannot admit with M. R. that the oily matter becomes fixed, in consequence of its oxydation (which is more naturally explained by the precipitation of the carbone, through the aid of the sulphuric acid), they conceive that his process merits to be more generally known and studied with a view to its improvement.

On the acetic Acid. By Messrs. PLANCHE *and* BOULAY.—*Ann. de Chim.* No. 161.

Results of Experiments.

1. The acetic acid obtained by the distillation of a mixture of sulphate of copper and acetate of lead, is always mixed with sulphurous acid, which, however, does not manifest itself till towards the end of the distillation.

2. It cannot be completely deprived of this sulphurous acid by the rectification proposed by M. *Dubuc* (viz. letting it stand for twenty-four hours upon salt of tartar and porphyrized black oxyde of manganese, and subsequent slow distillation).

3. This acid, even when totally freed from sulphurous acid, has never so lively and agreeable an odour as that which is obtained from the crystals of acetate of copper.

4. It will be preferable to dry the sulphate of copper before employing it.

5. Those are mistaken who have asserted that no carbonic acid is obtained in this operation.

6. This disengagement of carbonic acid no more proves the decarbonization of the acetous acid to become acetic, than the sulphurous acid does the superoxygenation of the vinegar; but it affords, on the contrary, reason to believe that the difference between these two substances is foreign to their state of acidification.

Discovery of a new vegetable Substance. By M. Rose.—*Gehlen's Jour.* 1804.

A CONCENTRATED decoction of the root of elecampane (*inula helenium*) deposits, after standing, a powder resembling starch, but differing from it in its principles and habitudes with other substances. It is insoluble in cold water. It dissolves very well in boiling water, but, on cooling, the greater part of the dissolved substance is deposited. A solution of gum arabic is thicker and more tenacious, and froths lightly, which that of the elecampane powder does not. Alcohol separates the elecampane powder from its solution in water, but does not gum arabic. Thrown on burning coals, the powder melts, emits thick fumes, and leaves little residuum, wherein it differs both from starch and from gum. On red-hot iron it burns with a brisk light flame; and leaves a very trifling coaly residuum. Both starch and gum comport themselves otherwise, under like circumstances. By dry distillation, an empyreumatic acid is produced from it, but no empyreumatic oil. Nitric acid transforms the powder into malic and oxalic acid, and when added in excess, into acetic. Gum arabic, treated in the same manner, furnishes saccholactic acid, and starch fat. Hence this substance appears to be of a nature intermediate between gum and starch, and probably exists in a great number of other substances.

On the Decomposition of the Sulphate of Lead by the muriatic Acid. By M. Descotils.—*Bulletin des Sciences*, No. 96.

If the sulphate of lead be treated with rather concentrated muriatic acid, it will be entirely dissolved, provided we use a sufficient proportion of acid. On cooling, a large quantity of muriate of lead crystallizes: this may be obtained much more speedily by the addition of a small quantity of cold water. If we separate the supernatant liquor from the crystallized salt, we may obtain from the former a precipitate, by the muriate of barytes. The muriate of lead dissolves in the water, and may afterwards be almost entirely decomposed by the sulphuric acid,

which forms with it sulphate of lead. This fact merits the attention of chemists, and may be of importance to the analysis of mineral and metallic substances. If an alloy contained a small quantity of lead, and we were obliged, in order to dissolve the alloy, to employ nitro-muriatic acid, the sulphuric acid might very possibly give no indication of the presence of the lead, and a less might be experienced, which we should not know to what cause to attribute.

Of the Use of Fumigations of oxygenated muriatic Acid for disinfecting the Air of the Rooms in which Silk-worms are kept.—By M. PAROLETTI.—*Bulletin des Sciences,* No. 96.

BY employing fumigations of oxygenated muriatic acid, according to the method of M. Guyton, M. Paroletti caused a very destructive malady which prevailed among a number of silk-worms, to subside entirely within a few days.

Notice respecting a highly-oxygenated Ore of Manganese. By J. C. DELAMETHERIE.—*Journ. de Physique.*

THIS ore is found in a marble quarry at Dyo, in the department of the Allier. Some specimens brought by M. Delametherie to Paris, were analyzed by M. Godon-Saint-Memim, with the following result.

The metallic parts, separated, as accurately as possible, from extraneous substances, gave in the hundred parts:

Silex - - - -	5
Alumine - - - -	4
Caustic barytes, about - - -	2
Oxyde of manganese, at the minimum -	30
Oxyde of iron - - -	12
	53

The deficiency, which can be attributed only to the carbonic acid and the oxygene, indicates a large proportion of the latter: accordingly, when we treat this mineral by the muriatic acid, we obtain a great abundance of oxygenated muriatic acid, which proves this mineral to be an ore *very rich in oxygene.*

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, &c. IN THE MONTHS OF SEPTEMBER, OCTOBER, NOVEMBER, AND DECEMBER, 1805.

Mr. JAMES SHARPLES's *Patent for new-invented Combinations and Arrangements of Implements and mechanical Powers, and certain Principles and Forms of Tables useful for Surveying, &c. Dated November* 1804.

MR. Sharples's inventions consist, first, of two or more wheels, pullies, rings, rollers, chains, or cords, toothed or notched with different numbers, and so arranged as to be capable of being impelled an equal number of teeth or notches at a time, so that a successive variation or combination of their points will take place, and the number of producing impulses may be ascertained. What distinguishes this part of the invention from all others intended for ascertaining distances, and measuring animal or mechanical motions, is, that the wheels, pullies, &c. composing the instrument may be separated and inclosed in different compartments of the same box, or in separate boxes, or separate rooms, provided they are equally moved by the same power, a notch at a time; or, when they are rings, rollers, &c. of different diameters, an equal portion of their peripheries.

The endless variety in which the combination-wheels may be put in motion, such as cords, chains, pinions, springs, levers, endless screws, pendulous and falling weights, &c. must be obvious to every mechanic. We shall here mention some of the contrivances described in Mr. Sharples's specification.

Let a double spring, made weakest at its extremities, be put round two or three ratchet-wheels on the same arbor, fixed in a shallow box; if the sides are pressed together by any mechanical or animal agency, one end of the spring will push forward the wheels, and the hook of the other will approach it; and, when the spring is set at liberty, it will, by returning into its situation, perform the same office, whilst the opposite end will escape over a tooth in each, so that every impression on the spring will impel the wheels forward. Now, if a cord or wire, fixed round the spring, which may be either confined in a perforated groove cut in the box, or in the sides of the spring, be alternately braced and relaxed, by pulling at the outer end, the required action will

be performed: or, if the sides of the spring are any way pressed outwards, by its return inwards the same effect will take place; so that by means of a string, wire, &c. motion may be communicated to the instrument from a considerable distance. If it be required to give it action on the inside of carriages, let there be a spiral spring, box, and pulley, moveable upon an axis, at the end of another spring, which must be screwed to the projecting part of the axletree bed, that covers the whole of the wheel within a quarter of an inch. Upon the hob screw a slip of wood or metal, or a strap, which, by coming in contact with the pulley, will give it a few turns at every revolution of the carriage-wheel, and wind up the spiral spring in the box. Then, as soon as the pulley has passed over the projection on the hob, the spiral spring will return again into its situation. Now, if a cord or wire is fixed to wind round the pulley, and be conveyed to the spring of the instrument within the carriage, it will put it in motion by alternately bracing and relaxing it. Again, if the spring and pulley be fixed to a horse's neck, and a set of combination-wheels are connected with the spring-box, the real distance a horse, or other animal, moves, may be very nearly ascertained. Let the spring-box have a click attached to it, so that when any length of cord is drawn from it, the click shall move a wheel with any number of small teeth in it, which wheel shall have a pinion connected with the combination-wheels of 101, 100, and 99; every step the horse takes, a quantity of teeth will be driven forward in the first wheel proportionate to the length of the horse's pace, which will be all summed up in the combination-wheels; and lest any person should find a difficulty in applying Mr. Sharples's rules for reckoning, he has contrived variation and combination tables; for which, and a particular account of their uses, we must refer to No. 40 of the second series of the Repertory of Arts and Manufactures; for we confess we do not comprehend the greater part of this specification.

Mr. Job Rider's *Patent for certain Improvements in the Steam Engine. Dated March* 1805.

These improvements consist, says the inventor, 1st, In lining the steam cylinder with a soft metal, of a sufficient thickness to admit of finishing the inside of the cylinder of such metal, by draw-boring, or otherwise: 2dly, In applying a hollow piston-rod answering the purpose of an eduction-pipe: 3dly, In the order of opening and shutting the valves: 4thly, In regulating the speed of the engine by a pendulum.

As to the first of these, Mr. Rider's object is, by applying lining to steam-engine cylinders, to obtain a more perfect inside than can

be made when cast-iron only is used; he also recommends finishing the inside by draw-boring, making each stroke lengthwise. Thus the piston is made to fit closer into the cylinder than is commonly done; so that little or no steam can escape past the piston, and of course less steam will be consumed in working the engine.

Secondly, the piston-rod being made hollow, and acting through a stuffing-box fixed upon the piece which stops the lower end of the steam cylinder, the piston in that cylinder being fixed to its upper end, and the lower end acting through a stuffing-box into a condenser: thus the piston-rod serves the purpose of an eduction-pipe, having a valve to the upper end (above the piston in the steam cylinder) opened and shut occasionally in working the engine by the necessary apparatus connected to it. This contrivance of a hollow piston-rod to serve as an eduction-pipe, enables the engineer to obtain a direct motion and power for the purpose of pumping water, without beam or lever, and renders the engine more simple.

Thirdly, the order of opening and shutting the valves (in number, five) cannot be perspicuously explained without reference to a figure. It must suffice, therefore, to say, that upon comparison of this method with that in common use in other engines, it will appear that Mr. Rider's promises a saving of steam.

The fourth, and, in our opinion, the most important of these improvements, consists in the regulation of the speed of the engine by the pendulum and weight. The nature of this contrivance may perhaps be understood from the following description. Upon a horizontal arbor, which we will call the *main arbor*, are placed three wheels, a drum or barrel, and a nut. One of these wheels, viz. the main wheel, is fitted by means of a socket upon the main arbor, to turn upon that arbor, and has teeth both upon the exterior and interior periphery of its rim. Between this wheel and the barrel is a nut fixed to the arbor, its diameter being one third of the interior diameter of the main wheel; and this nut has teeth surrounding its convex surface. The moveable barrel turning upon the main arbor, has its diameter rather less than the exterior diameter of the main wheel, and it carries a cord with a weight hanging at its end, acting like a clock-weight: besides this, the ends of the drum are pierced with two orifices each, at about the distance from the main arbor of half the exterior radius of the main wheel; these holes serving as bushes or pivot holes, in which an arbor turns, that carries a wheel whose diameter and number of teeth are respectively equal to those of the nut: the latter wheel may be called the *barrel-pinion*. By these means the barrel may be turned round upon the main arbor, while the arbor itself is turned by the nut, the nut being acted upon by the barrel-pinion, at the same time that this pinion acts upon the interior teeth of the main wheel. Immediately above the main wheel are the axle and pinion of a scapement wheel, on which wheel a

pendulum acts by pallets, &c. nearly similar to those in Graham's dead-beat. Near one end of the main arbor there is a ratchet-wheel, and wheel and click; and near the other end a wheel, which is acted upon by an endless screw upon a horizontal shaft, worked by the general operation of the steam engine. This arrangement serves to regulate the rate of the engine's motion; for the turning of the worm-wheel by the general motion of the engine, causes the weight to be raised which hangs to the cord that folds upon the drum; and this weight is connected to one end of a lever, the other end of which is attached to the valve No. I. in such a manner, that the degree of opening of that valve depends upon the altitude to which the weight is raised. The aperture of this valve is formed like an inverted cone; and while this valve shuts and opens twice in every stroke, the lever does not prevent such opening and shutting, but merely limits the extent of the opening, by the springing up of a rod connected with it. By this contrivance it happens, that when the weight is highest the valve is least opened; and when the weight is lowest, the valve is most opened. Hence it is evident, that should the engine wind up the weight by turning the worm faster than the pendulum permits it to descend, by the turning of the barrel, the aperture of the valve will be contracted, and *vice versa*. Little power is lost by these means, and the speed of the engine can be accurately regulated by properly adjusting the length of the pendulum, and the numbers of teeth in the wheels and pinions. As to the ratchet-wheel and click, their sole use is to prevent the weight from drawing the line off the barrel when the worm-wheel is thrown out of geer.

Observations. — Mr. Rider's contrivance for regulating the steam engine is worthy of admiration, for the beautiful simplicity and compactness of the clockwork; it presents also the singular and almost paradoxical phenomenon in mechanism, of a weight acting on machinery without descending, and in it a small force (that of a pendulum of the common size) is made to govern the vast power of the steam engine in the most effectual manner, while all risk of the delicate mechanism annexed to it being damaged, or disturbed, by its union with such a superior power, is removed by the very contrivance that forms a part of the communication between them.

There can be little doubt that this invention will regulate a steam engine to a much greater degree of exactness than the centrifugal apparatus now used for that purpose: and where this great exactness is an object, it certainly is preferable, though the cost might be somewhat more; but for the common uses to which steam engines are put, of pumping up water, or hauling up weights, this great nicety would be no material advantage, the common fly-wheel having been found to answer sufficiently well

for equalizing their motion for these purposes; which fly-wheel must be a constituent part of Mr. Rider's engine as well as of every other. It seems rather doubtful, that there is any advantage in making the weight of the regulator act on a valve, which has been before destined to another use, instead of an additional valve entirely appropriated to this purpose; as in the first instance there must be some contrivance added to accommodate the single valve to two different purposes, which must be very simple indeed not to exceed the machinery of an additional valve in complication.

The use of the extra valve proposed by Mr. Rider to prevent the waste of steam, though not the most striking part of his invention, is perhaps that which will be the most profitable, for it is the only one that produces a direct saving; but what the degree of this saving would be is hard to calculate, and could only be determined by observing how much less fuel an engine on this plan consumed, than one with the usual number of valves, in every other respect equal to it, and performing equal work: it does not seem probable, however, that the difference would be much.

It does not appear that Mr. Rider's invention of the hollow piston-rod, to act as an eduction-pipe, would have any good effect, that would at all compensate for the difficulty it would occasion in applying the valves properly to an engine so constructed: though there can be no doubt, that the inversion of the main cylinder, to make the piston-rod communicate directly with the pumps, or other machinery, so as to preclude the use of the balance-beam, would be attended with considerable advantage, even more than Mr. Rider mentions; but this he with great propriety states not to be his invention; by which he shews a degree of candour no less praiseworthy, than the great ingenuity and knowledge of mechanism displayed in the other parts of his invention is creditable to his professional skill.

Mr. William Wilkinson's *Patent for improved Pantiles, for covering Houses and other Buildings. Dated August* 1805.

These tiles are of two kinds, denominated *upper* and *lower*, from their relative situation when disposed into a covering. Each lower tile is so formed, that the greater or receiving end may admit the less or dripping end of the next tile above it into its cavity, after the manner of troughs leading into each other. At the greater end of this tile a perforation is made, through which a clout-nail may pass into the lath that supports it. When two lower tiles are placed properly at the side of each other, an upper tile will receive their raised edges into its cavity, be supported by

the shoulders formed in them, and cover the space between them closely.

Mr. Wilkinson has given drawings of the moulds in which the tiles are to be made, and observes, that it is only with regard to the shape, not the size or the method of making the tiles: notwithstanding this, however, he states his process for manufacturing tiles to be as follows: The moulds consist of three parts; *i. e.* the stock, the mould-board, and the frame. The stock being made fast on a table by a staple and wedge, the mould-board and frame are placed on it: the mould is then filled with earth, and struck off in the usual manner; and a small quantity of sand is thrown on the face of the tile. The tile-frame and mould-board are next taken off the stock, and placed on a hand-board with the face of the tile downward: then, the tile and mould-board being forced out of the frame, the mould-board is taken off, and the tile laid on a floor, or placed on a stage (formed of boards), similar to those used for the common pantile. When the tiles are sufficiently dried, they are dressed on a horse or stool resembling the mould-board, proper allowance being made for the shrinking of the tiles. For the dressing, a slay or beater is used, flat on one side, but a little hollow lengthwise on the other: the flat side is used for the face of the tile, the hollow side to beat up the edges. The tiles, after dressing, are paired face to face, and chequered; and in this state they remain till they are perfectly dry, and fit for the kiln.

The specification contains likewise a description of a stock-shave, cutting-knife, and other tools used by Mr. Wilkinson in his process; but these need not be minutely described here.

Mr. Thomas Rowntree's *Patent for a new-invented Axletree and Box for Carriages. Dated April* 1805.

In this invention the thicker part of each conical arm of the axletree has a moveable collar fitted to it, occupying about one fourth of the length of the truncated cone: a box is screwed and fixed firmly to the collar, and extends nearly to the smaller end of the axletree; about two thirds of the length of this box it does not touch the axletree, but leaves a hollow for the reception of the oil. A nut is screwed on the arm before the cone, to keep the mobile collar in its situation on the arm. At the larger end of the arm is a leather collar, to prevent the escape of the oil; and at the smaller end a cap is screwed to the end of the box, to receive and preserve the oil, as in other boxes now in use. The proposed advantages in this construction, are safety in travelling, and less labour for the horses. Indeed there will be a diminution of friction; but we conceive it will not exceed the diminution resulting from many other well-known contrivances.

Mr. William Kent's *Patent for such Additions and Improvements on a Sort of Candlestick (in common Use) as will prevent accidental Fires in the Use of Candles. Dated July* 1805.

These "Additions and Improvements," as the patentee chooses to call them, are very slight alterations of the guard candlesticks, which have been long used in chambers where persons burn a light through the night. The candlestick itself is in the shape of a conic frustum with its smaller end downwards; this is to contain water; to prevent which from being dashed over as the candlestick is carried about, another conic frustum is joined to the former, having its less end upwards. A vertical wire on the candlestick serves for a cylindrical guard (made of either transparent horn or glass), to slide up and down; the candle burning within the guard. The socket in which the candle stands is also conical, increasing downwards, and has a hole in its bottom, to admit water, &c.: the advantage of which is, that when the candle has burnt down to the socket, the small remaining part instantly falls into the water, and the light is extinguished.

Mr. Thomas Chapman's *Patent for a Mill for tearing, crushing, and preparing Oak Bark, to be used by Tanners. Dated July* 1805.

The mill described by Mr. Chapman, in his specification, is to be worked by horses; but the same general contrivance may be worked by either steam, wind, or water, according to the wishes of the proprietor, and the situation where the machinery is to be erected. A large horizontal face wheel gives motion to a horizontal tumbling shaft, which unites with the gudgeon of a large rag-barrel: two other cylinders are posited horizontally with respect to this rag-barrel, one on each side; one of these is a smaller rag-barrel, the other is a spike roller. A moderate-sized wheel at one end of the larger rag-barrel has its teeth to play into the leaves of a pinion on the end of the spike-roller, thus communicating motion to that roller and to a large fly-wheel, turning on the same axis: two or three other smaller wheels and pinions communicate motion from the larger to the smaller barrel, and in such manner that the latter has a considerably less velocity than the former, and turns the contrary way. A horizontal hollow frame contains the barrels and spike-roller, and the bottom plate of this is moveable by means of screws, so as to be capable of adjustment and placed at a suitable distance from the rag-barrels, to act as a binding-plate. Two screws, whose heads are at one end of

this frame, serve to place the smaller rag-barrel at a convenient distance from the larger. This large barrel has about 20 rows of plates with their indentations turning downwards, while the indentations of the smaller barrel project upwards; so that this latter barrel gathers the bark and holds it fast, while the larger one tears it to pieces: and the spike-roller on the other side of this larger barrel keeps it clean. A sloping spout conveys the torn bark from the grinding-plate to an inclining cylinder, posited like the cylinders in dressing-machines for flour-mills: the wires of this cylinder are of two different kinds with respect to fineness, the coarsest being lowermost; and beneath it two bins are placed, the one to receive the finer dust, the other the coarser or hand-dust from the cylinder; next to these stands a basket to receive the torn bark as it passes through the cylinder.

Observation.—This is, altogether, a simple and ingenious piece of machinery; and will suggest hints applicable to various other useful purposes. It furnishes a very natural and obvious method of grinding the bark to any degree of fineness the workman shall choose; and on account of its simplicity, may always be erected at a moderate expense (compared with many other bark-mills), even after the patentee has received an adequate remuneration for his exclusive right.

Sir GEORGE WRIGHT'S *Patent for a Machine for cutting out of solid Stone, Wood, or other Materials, Pillars or Tubes, either cylindrical or conical, with great Saving of Labour and Materials. Dated March* 1805.

THE end of the invention which is the object of this patent is to form or cut stone, wood, or other materials, into cylindrical or conical tubes or columns, or other circular work, without the labour and expense of chipping or hollowing; and by these means to form pipes, cisterns, cantilivers, chimney-tops, arches, Gothic-work, ovals, inverted curvatures, &c. The invention consists principally in the application of a saw, or instrument for a like purpose, to a frame turning on an axle passing through a hole previously drilled in the stone or other substance to be sawed; and thus working or cutting from a centre or in a tangent of any given circle or oval.

Four drawings accompany the specification of this patent: the first of them exhibits the boring apparatus. The frame of this is constituted chiefly of four vertical posts, connected firmly by several horizontal beams: near the lower part of this frame are fixed two horizontal rollers, parallel to each other, and each turned by a winch-handle; round each of these is folded part of a cord, which passes from thence vertically to the top of the frame, where

each turns over a pulley into the horizontal direction; they meet and pass over a third pulley in the mid-way between the other two, and thence descend and pass round a fourth pulley (this latter being a moveable one) directly below the third: from the block of this fourth pulley hangs a swivel, to which the borer is suspended in a vertical position, having liberty to take a rotatory motion. It is obvious, that by turning the rollers at the bottom of the frame, this arrangement will occasion the borer to be raised or lowered at pleasure: or, the apparatus may be so constructed that the weight of the borer and its appendages shall be just sufficient to overcome the friction of the rollers and pulleys, and the borer may descend as it performs its work. Part of the boring bar is made square, and runs through a vertical shaft, the inner part of which is made square to fit the bar (though not quite close), and the outer part cylindrical, with a toothed wheel at its bottom. Two winch handles with fly wheels are fixed at the opposite extremities of a horizontal shaft, upon which is a toothed wheel that drives another wheel of about half the size of the former; a third wheel on the same axle as this latter, and of nearly the same size, drives the toothed wheel on the shaft of the boring bar, and thus communicates the rotatory motion to the borer. The substance to be bored may be conveyed under the boring frame by a truck, or any low carriage.

The second figure shews the method of sawing a cylinder. Two strong, but portable, frames of iron or of wood, are constituted each of four pieces, and may be so connected together by means of grooves and screws as to form a triangle and a line from its vertical angle to any point in the base. Lay the block to be sawn so that the perforation drilled through it shall be nearly horizontal, and put through this perforation an iron bar which shall just have room to slide freely to and fro, as occasion may require: at each end of this bar fix a corresponding angle of the base of the two triangular frames; and let two other bars of equal length connect the two other corresponding angles of these triangles, in order to give firmness to the whole frame; lastly, let the two ends of the saw be screwed on the bases of their respective triangles, each at an equal distance from the axis of motion. This construction will, it is obvious, enable the workmen to place the saw at any proposed distance from the hole drilled through the middle of the block, and then by giving the alternating motion to the saw-frames the cylinder may at length be cut from the block, as required.

The third drawing exhibits the method by which arches of variable curvature may be sawn, from centres *out* of the block: this may easily be conceived without any minute explanation; in fact, it differs but little from methods which have been long in use.

The fourth diagram illustrates the method of sawing conic frustums. In this case two circular frames of wood or iron are fixed

to those parallel ends of the block which are intended to coincide with the bases of the frustum, circular slits being previously cut in these frames to equal in magnitude the circumferences of the two ends of the proposed frustum; the saw being worked in these slits or grooves will manifestly cut the conic surface from the block. Here, it is evident, there is no occasion to drill a central orifice.

Observations.—In this specification, there is a conciseness verging on obscurity. The *object* of Sir George's invention is stated in the specification, but there is scarcely a word that has a tendency to explain the *nature* of it. The marginal drawings, however, in some measure make up the deficiency; and from them, chiefly, we have deduced the preceding account. Sir George's first and third contrivances, viz. for sawing cylinders and cones, are certainly very ingenious; and they possess this peculiar advantage, that they serve for cutting concave as well as convex surfaces, and may therefore be conveniently used in forming hollow cylinders and conic frustums, such that their substance shall be of equal thickness throughout. The plan of drilling a central perforation has not, as far as we know, been introduced into practice before, though the idea is sufficiently obvious; and it will probably excite the surprise of practical men that it should have been so long overlooked. It is, undoubtedly, far more commodious than the method (sometimes adopted formerly) of bending the axis of the saw-frame, placed vertically, into a crank form, like that in the axis of Mudge's escapement. In this method, the block to be sawn was obliged to be elevated so as to allow nearly half of the frame-work to be beneath it; and the process of this elevation was always inconvenient and often hazardous: but in Sir George's method this inconvenience and danger (however ponderous the blocks may be) is obviated.

As to the contrivance for boring the central orifices, it displays far less ingenuity than the methods for sawing: besides the unnecessary complexness of the apparatus, the chips and dust arising from the boring being performed vertically will tend very much to clog and impede the work. Instead of having the proposed perforation drilled vertically, we conceive it would be accomplished more conveniently and in much less time, if the block were posited horizontally; and the apparatus employed might be something like the following:—On a carriage having four low wheels, let two vertical pieces of wood or iron (each having a hole just large enough to admit the borer to play freely) be fixed two or three feet asunder, and so contrived that the pieces and holes to receive the borer may, by screws, &c. be raised or lowered at pleasure, while the boring is prevented from sliding to and fro by shoulders upon its bar, which are larger than the holes in the vertical pieces, and which press against those pieces as the borer revolves: let a part of the boring bar between the two ver-

tical pieces be square, and a grooved wheel with a square hole of a suitable size be placed upon this part of the bar; then the rotatory motion may be given to the bar by an endless band which shall pass over this grooved wheel, and a wheel of much larger diameter in the same plane, the latter wheel being turned by a winch handle in the usual way. As the boring proceeds, the carriage with the borer may be brought nearer and nearer to the block, by a lever (or levers) and weights, after the manner commonly practised in bringing up the auger in the boring of ordnance.

Mr. HAWKINS's *Patent for an Invention applicable to musical Instruments, the Principles of which are also designed to be applied to other Machinery. Dated November* 1800.

THE improvements which are claimed by this patentee, are comprised under the following general heads:

1st. Metallic elastic strings are made by the turning of wire into a spiral or serpentine form, or made with links, like a chain, to produce a deep sound, and yet occupy a space much shorter than usual.

These spiral strings are also intended to be applied as bands, either single or two or more sewed side by side, into a piece of cloth, leather, &c. for turning lathes, and all other machinery where bands are used. They are also intended to be fixed to saddle-stirrup straps, to render them elastic, and thus hinder the jolting of horses from affecting the riders. And a number of these combined together, are proposed to be applied to coaches and other carriages where springs are used.

2dly. Gut or silk, or other strings, are rendered water-proof to resist the action of the varying atmosphere, by which strings are, otherwise, frequently put out of tune. These water-proof strings are to be applied to all musical instruments where they can be used.

3dly. The strings of piano-fortes, and all other finger-keyed instruments, are to be fixed in nearly a vertical position; thus to make them in a more elegant and convenient shape than any heretofore made.

4thly. One end of each string of all stringed instruments is to be connected with a spring; or a fuzee or levers, to which a spring is fixed, so that it shall act with equal force on the string when it contracts or expands.

5thly. Sliding frames or carriages are proposed, for the purpose of tuning stringed instruments, each frame being worked by a screw in a metallic frame, to which a string is attached; so that several strings may be stretched at the same time.

6thly. There is to be attached to harps, and all other instruments to which it can be applied, a roller worked by pedals, having pins or other projections acting upon levers, which may

press on any of the strings, in order to vary the tones by shortening their vibrating part.

7thly. To instruments from which the tones are produced by hammers, there is to be affixed a roller made to turn very rapidly, having projecting parts to strike by levers on the tail of the hammer, thus making the hammer to continue striking the strings so long as the finger-key is kept down. This is called the *Poiotonic* stop.

8thly. It is proposed to make all musical stringed instruments without any box or hollow space under the sound-board.

9thly. It is proposed to draw a lengthened tone from a string or bell, or other vibrating body, by the revolution of a hoop or ring, on the inside of which hairs are stretched, in equal chords of the circle, forming a regular polygonic elastic surface.

10thly. In all hammer instruments there are to be introduced between the hammers and sounding bodies, by a pedal or otherwise (gradually, at the pleasure of the performer), pieces of leather or other substances, the parts of which are of different density, thickness, or hardness, so as gradually to vary the tone from loud to soft, and *vice versa*.

11thly. The frame which contains the finger-keys of piano-fortes, organs, &c. is to turn on pivots or axes, to shut up, so as to contract the space occupied by the instrument when not in use.

12thly. A piece of machinery, worked with a pedal, is to be attached to a stand on which a music-book is placed, to turn over the leaves at pleasure while the hands are otherwise employed.

Observations.—There being much novelty as well as ingenuity in the several particulars of this specification, we have described them pretty much at length. Spiral strings tend greatly to diminish the magnitude of the exterior frame of a musical instrument, and the arranging them in a vertical position (though this contrivance, we believe, was adopted some years before the taking out of Mr. Hawkins's patent) adds much to the convenient disposition of the instrument, particularly in small rooms. The process for rendering the strings unsusceptible to the changes in the atmosphere is very advantageous; and we are enabled to assert, from personal knowledge, that strings which have been subjected to this process, do not for a long time undergo any perceptible variation in tone, with regard to gravity and acuteness. Another contrivance, which we deem of real value, is that for turning over the leaves: every musical amateur has often experienced the many vexatious interruptions, and awkward chasms in the harmony, occasioned by the performer's turning over the leaves himself; and will be happy to possess so ingenious a method of getting rid of these unnatural breaks in the execution of a favourite piece.

The application of spiral strings to stirrups and carriages, will, we conceive, be productive of numerous advantages: though they

will require considerable care in the manufactory, as it is well known that spiral strings, when stretched nearly to their *maximum*, are always in danger of breaking suddenly. The best way to guard against this inconvenience, will be to make the springs of far greater strength than will ever be required in the particular case for which they are about to be employed. The introduction of spring bands to lathes, &c. will be very convenient and useful, as, by reason of their elasticity, they will readily accommodate themselves to different grooves in the wheel and mandrell. This has hitherto been effected by various contrivances; the most ingenious of which is practised by a very skilful mechanist, Mr. Maundslay, of Margaret Street, Cavendish Square: this contrivance we hope to explain in some future Number, when we purpose giving an account of the truly curious turning apparatus invented by this gentleman.

Messrs. HOBSON *and* SYLVESTER'S *Patent for manufacturing Zinc. Dated April* 1805.

THE discovery upon which this method is grounded, is, that zinc (which has hitherto been considered as possessing no malleability) is capable of being extended by hammering, wire-drawing, &c. provided it be kept at a certain heat during those operations. The heat required is between 210 and 300 Fahrenheit. The zinc is cast into ingots of a convenient figure and magnitude, and the best form for making of wire is that of a cylinder. These ingots or pieces are then heated to the above-mentioned temperature in an oven, or by any other method. For wire, the cast cylinders are extended between rollers, till their lengths have been increased to about four times; after which they may, if not very thick, be drawn through the wire plates without farther heating. Plates of zinc may be made by working it from the ingot between rollers, at the above temperature; and those plates may be hammered up into culinary and other vessels by the same treatment as is applied to other metals, taking care, when the size or form of the vessels requires it, to heat the zinc at proper times during the operation. When pieces or plates of zinc are to be united together, it is done by means of a solder consisting of about two parts of tin and one of zinc; or otherwise the common glazier's solder may be applied for the same purpose.

Observations.—The many uses to which zinc has been applied for ages in China (see our first Number, p. 51) renders it almost certain that the above art has long been known there. The discovery, however, is not the less valuable on that account; for as there are abundant mines of zinc in the Mendip Hills and elsewhere in this country, it is probable that the wrought metal may hereafter be

exported to China to advantage, where a ready market will be found for it. Thus an important advantage will be obtained for the trade of this country, which is much in want of articles for the Chinese market. Moreover, as zinc is free from the poisonous qualities of lead, and may in all cases be substituted for that metal or for pewter, for holding alimentary substances, the discovery is also very valuable on that account, and it is to be hoped that it will hereafter totally supersede lead and its alloys for such purposes.

Mr. Bramah's *Patent for sundry Improvements in the Art of making Paper. Dated April* 1805.

These improvements are directed to four distinct objects in the process of making paper. 1. To perform the office of moulder of the sheets by machinery. 2. To a contrivance for making paper in "*endless*" sheets. 3. To obviate the necessity of employing many presses for dry work. 4. To render the raising and taking down the ponderous frames on which the paper is hung in the drying-house unnecessary.

From the attainment of the first object it results that the moulding of the sheets may be conducted by persons not possessing the usual skill of those employed in the paper manufactory; and by such application of machinery, sheets of much larger than usual dimensions, can easily be made pretty uniform in their weight and thickness. To accomplish this, the dimensions of the vat, called the regulating reservoir, in which the stuff for moulding is usually put, are to be in length and width, exactly the same as those of the proposed sheet, and about 20 inches deep; this vat contains a frame or rim of wood, which is made to slide up and down at pleasure, and in such manner that the frame may be raised or depressed by a handle or winch applied externally. The paper mould is also carefully fitted on all sides to the interior of the reservoir, and is rested upon the sliding rim so as to be lifted up or lowered, still retaining an horizontal position when the frame is moved down or up for that purpose; the mould and frame moving always uniformly together. On the side or end of this reservoir near the bottom, is cut a tolerably large aperture, through which the water that filled the reservoir can quickly discharge itself. This aperture communicates with a hollow trunk; and there is another cistern, viz. the feeder or stuff-cistern, which has an agitator to prevent the unequal mixing of the pulp and water: but the minuter details of the various parts cannot well be given here.

When the whole is ready for action the regulating reservoir is filled with water till it discharges at the mouth of the external trunk; and then the mould, being at its lowest station, has the wire surface immersed more than a quarter of an inch below the

surface of the water; and the valve or lid which covers the mouth of the trunk being then shut, prevents the escape of the water from the interior of the reservoir. While the machine is in this situation, the sluice which opens the communication between the feeder above the mould is lifted up, and admits the stuff from the feeding cistern to flow upon the surface of the mould to any limited gauge allowed for the sheet: when this quantity has flowed, the sluice is quickly shut; and then, by the motion of the apparatus, which lifts and lowers the frame and mould, it is raised with more or less slowness, as experience may suggest, up to its greatest altitude. By opening the valve of the waste trunk at the instant the mould begins to rise, all the water is immediately discharged from above the mould by passing through the wire into the lower part, and is carried off to the former level of the waste, being thus prepared for the depression of another mould: for, the loaded one, when raised to its highest station, is made to push away on slides to meet the coucher's hand, who at the same time furnishes the alternate mould; and when the mould is again depressed, the waste valve being shut, the machine is fitted for a second charge; and thus the process is continued with ease and certainty.

By the second improvement, paper is made in sheets of any length and width whatever, by a circulating process performed with a wheel or circular frame, composed of rings of thin wood or metal, of three feet or more in diameter, and of a width suitable to the size of paper intended to be made. This wheel is mounted on a horizontal axis, and has a shield on each side the upper extremity of its periphery, made to fit the edges of the extreme rings, in a segment form nearly water-tight, so as to prevent the lateral discharge of fluid passing over the wheel. These rings are kept at their stationary distance by transverse thin bars or ribs similar to those used to strengthen a common paper mould; and when this is done, all the face of this wheel is covered or worked with wire so as to form a complete circular mould. This mould or wheel being placed so as to be capable of being turned by hand or otherwise, a feeding cistern, prepared with stuff (as before), is stationed above the wheel; and by means of a sluice or regulator, this stuff may be let upon the wheel in any required quantity, as that wheel is turning on its axis. Thus, while the water is uniformly carried off by falling through the wire, the pulp is left upon the wheel, as in the instance of the common mould, and a constant and endless process may be kept up to any extent. This Mr. Bramah calls an universal revolving paper mould, in addition to which he fixes a little above or below the horizontal plane passing through the centre of the wheel, and opposite to the feeding point, a roller covered with felt; such roller being fixed in contact with the wheel by means of two springs upon the axis of the former, which regulates and renders uniform

and gentle the contact of their peripheries as they are turning each other's round,—for it signifies not to which of the axes the mover is applied. This is called the couching roller, since it takes the paper from the mould as they mutually turn. Two other rollers are also covered with felt, or woollen cloth, and placed in firmer contact with each other, and between them the sheet is conducted from the couching roller. These are called squeezing rollers; and after the paper has passed through them, it may be passed successively between others, and thus made as dry as possible. The paper is then to be conducted over heated plates, charcoal, or other fires, or passed between the rollers of heated calenders; so that when it leaves the machine it may be fit for use.

By the third improvement the necessity of employing many presses for the dry work is obviated. Mr. Bramah constructs a press on what he calls his "patent hydro-mechanical principle," of sufficient power, capacity, and strength, to receive the largest sheets proposed to be made; and also competent to withstand the greatest exertion the preparation of each class of paper may require from the press. This press is to be stationed about the middle of the room where the dry-press work in a paper-mill is carried on; and a rail-road of wood or metal, similar to the rail-roads used in larger works, is extended in a straight line to some distance on each side of the press; so that, by means of this, carriages or planks, moving on small wheels or casters, may be wheeled into the press on one side, and pressed through it, to the opposite, when the process of pressing is completed. Instead of more presses, Mr. Bramah proposes to use a considerable number of another kind of apparatus called *retainers*, which consist of a top and bottom bed of wood or metal, of sufficient strength to resist the re-action of the paper when the press is slackened from its severest squeeze, and to retain it in its most compressed state for any required length of time, after the grasp of the press has been finally withdrawn: in these retainers vertical bars are fixed at the corners of the lower bed, slide through slits in the upper one, and have each several holes to receive wedges or keys; by which the upper bed of the retainer is made to preserve the state into which it has been pressed notwithstanding any efforts of the paper and felts to expand to the space they originally occupied. The process of moving these retainers under the press, fixing the upper bed, and then removing the retainer, by means of the rail-road, may be easily understood without dwelling upon particulars. It may just be observed, however, that the head of the press is made so much narrower as to admit the four bars which compose the sides or jambs of each retainer to pass it on each side during the upward motion of the press (for it must be recollected that in Mr. Bramah's press the lower part is compelled to move upward) as the paper is compressed; or, in some cases, four

holes are made through the head, or upper bed of the press itself.

By the fourth improvement, which saves the manual labour of raising up and taking down the cumbersome frames on which the paper is hung, much facility is given to the process of hanging and re-hanging the sheets exposed to be dried. The contrivance consists simply in having a proper number of frames something similar to laundress's clothes-horses, stationed at suitable distances from each other by means of upright posts, with grooves fitted to the frames, so that each may be slidden vertically up and down by means of lines and pullies attached to each, just like sash-windows double hung; so that while one of the frames is slidden up to touch the ceiling of the building with its upper edge, the one connected with it may be depressed till its lower edge, or the paper which hangs upon it, may come nearly in contact with the floor. Thus the paper may easily be hung on the frames while they are down within reach, and then they may be elevated to any convenient altitude for drying.

Observations.—The well-known and established ingenuity of Mr. Bramah, as a mechanical inventor, will always ensure a candid and respectful attention to whatever improvements he may suggest: and in the case of the present specification some material advantage will doubtless result from the adoption of his proposed contrivances. Of these, that described under the second head will be found of much utility in the manufacture of paper for large maps and for the hanging of rooms: but we apprehend that in actual practice some difficulties will arise (which may not yet have occurred to the mind of the inventor), from the effect of contrary forces during the motion of the wheel: with too rapid a motion the centrifugal force would cause the particles upon the wheel to be scattered, which are to constitute the paper; while with too slow a motion the effect of the gravitating force would cause several of them to fall off. Perhaps, however, Mr. B. may advert to these points when he speaks of the "speed which nothing but practice and attention to necessary circumstances can determine."

It ought also to be remarked that Mr. B.'s method of drying by "heated plates, charcoal fires, &c." cannot be universally applicable: in many kinds of paper where the beauty consists in softening the grain without destroying it, this method could not, we believe, be adopted at all. Under the action of the press in the common way, first with the felts, and then without them, the perfecting of the *grain* of the paper still proceeds; and the business of the *exchange*, as the workmen term it, completes the process: but in all this some days are generally employed; and we fancy the nature of the paper would undergo a great and depreciating change, if the sheets were attempted to be brought to the same state of dryness, in a few hours or minutes.

Mr. Bramah is not very accurate in the enunciation of his particulars: thus he uses the paradoxical term "*endless* sheets of any length or width whatever," when it is obvious he only means that, while the breadth is limited by that of the revolving wheel, its length may be continued *ad libitum* by his process. This may be considered by some, as a mere cavilling at words; but it should be recollected that specifications of patent-rights are *legal* instruments, and that, in many cases, intricate disputes may result from any deficiency in perspicuity in drawing them up. A gentleman may possess much merit in the construction and improvement of machinery, without having ever directed his attention to grammatical accuracy and the genuine import of words; and on this account it is with as great propriety that the drawing of specifications should form a separate employment to be conducted with skill and judgment, as that any species of conveyancing for the transfer of property should be exclusively performed by gentlemen of the law.

We do not wish to subtract an atom from Mr. B.'s ingenuity as a mechanic, but it would be unjust were we to suffer the assumption of a principle long known as his own, without animadversion. This gentleman still continues to speak of the press on *his* "patent hydro-mechanical *principle*." His hydro-mechanical principle! He might as well assume to himself the discovery that water is a fluid; for the principle has been known almost as long as the *quaqua versum* pressure of fluids. When Dr. Wallis raised 64 pounds upon a bladder by blowing into it with a pipe, he had recourse to the same principle.—When Otto Guericke of Magdeburgh (the inventor of the air-pump) made a child not only balance, but overcome the pull exerted by the emperor's six coach-horses, by merely sucking the air from beneath a piston, the feat was performed by means of the same principle: and when any philosophical lecturer thrusts up a set of ponderous weights, by pouring water into the tube of hydrostatic bellows, he still accomplishes it by the same principle, even by Mr. Bramah's "*patent* hydro-mechanical principle." So that although this gentleman is certainly deserving of much praise for introducing to public notice a compendious machine of immense power, susceptible of great strength, and free from most inconveniences of teeth, pinions, and racks; yet we hope he will in future rest satisfied with commendation thus limited, with respect to his press, and not injure his character by assuming to himself the discovery of a principle which has been known to philosophers for centuries.

Mr. BARTLEY's *Patent for a Method of refining Sugars. Dated July* 1805.

THE method is this: Charge the sugar-pans with the usual quantity of lime-water; and for each ton weight of sugar to be refined, allow at the rate of ten gallons of skimmed milk, more or less, according to the quality of the sugar. Mix five gallons of such milk with the lime-water, then skip the sugar, and after the sugar is skipped, let it remain in the pans till the next morning, when the whole, so mixed, is to be stirred together; and after taking off the first scum of the sugar, add more skimmed milk, and continue to repeat the same, after each scum of the sugar, till the liquor is perfectly cleared.

Mr. BARNETT's *Patent for regulating the Introduction of Air into Vessels, to prevent the Liquids contained in them from becoming flat or dead. Dated November* 1804.

THE invention consists of a tube, resembling in shape, in the upper part, an inverted syphon, into which is to be inserted such a quantity of quicksilver, or other fluid, as will fill up its diameter at the curve, or circular bottom of the instrument; the long leg or branch of which is to be inserted into the vent-hole or aperture in the upper part of the vessel, which aperture should be so closed as to prevent any air from passing into or out of the vessel, excepting through the tube. The consequence will be, that by every alteration, either in the quantity or state of the fluid within the vessel, the fluid in the tube will be operated upon, and will vibrate or be forced towards the enlarged part of either of the branches of the part of the tube here denominated an inverted syphon, so as to permit a sufficient quantity of air to introduce itself into the vessel, or to emit itself therefrom as occasion may require; immediately after which the quicksilver or fluid will resume its situation, operating as a perpetual stopper, valve, or regulator. By this means the liquor will be prevented from becoming flat, notwithstanding a diminution of its quantity, and the vessel will also be prevented from bursting during its fermentation.

Mr. LUCAS's *Patent for separating the Impurities from crude or cast Iron without fusing it, and of rendering the same malleable. Dated May* 1804.

THE pig, or cast iron, being first made or cast into such form as may be most convenient for the purposes to which it is to be applied, is to be put into a steel converting or other proper furnace, with a suitable quantity of iron ore, metallic oxydes, limes, or their combinations, previously pulverized; or with any other substance capable of taking up the carbon of the crude iron. A degree of heat is then to be applied sufficient to effect an union of the carbon of the cast iron with the substance used, and continued as long as shall be necessary to make the iron either partially or pertectly malleable, according to the uses for which it is intended. The proportion of the several substances made use of, and the degree and duration of the heat to be applied, must depend not only on the nature of those substances, but also on the nature and quality of the pig, or cast iron; a knowledge of which can be obtained only by experience. Articles manufactured of cast iron may be improved by the same methods; only, when the articles are small, a less proportion of the substances for producing malleability will be required, and a less degree and continuation of heat.

Mr. WEDGWOOD's *Patent for a Composition for making Glass. Dated October* 1797.

THE composition consists of alkaline salt-pieces, or parts of china, or earthenware pitchers, or pieces of baked clay, old plaster moulds, or calcareous earths, borax, siliceous earths, and terra ponderosa. The alkaline salts and borax are used either in powder or in solution, though the solution is preferred. When the alkaline salts are used in solution, a solution of alkaline salts is made in water, and into this are thrown pieces of china, earthenware, or baked clay, previously heated to redness; and to these are added plaster-moulds, or calcareous earth, first slacking them in a solution of borax in water, when borax is used in solution; also siliceous earths and terra ponderosa are added. These articles are all ground together and heated over a slow fire. When the alkaline salts and borax are applied in powder, they are used in the same manner as in glass-making. When the articles have been ground and dried, the whole is put into a melting-pot, and fused with a strong heat; and when in

perfect fusion it is poured into cold water. The proportions of the different articles depend, in a great measure, upon the quality of the articles, and the degree of hardness required in the glass.

Mr. MARSLAND'*s Patent for certain Improvements in sizing Cotton Yarn. Dated July* 1805.

THE invention consists in the extraction of the air from a vessel containing the cotton yarn which is to be sized, and consequently from the cotton yarn itself, and applying the size to the yarn while the air is so extracted. The more completely the air is extracted, the more perfect the operation will be.

For this purpose the yarn is put into a vessel, or receiver, made perfectly air-tight: then, by means of an air-pump connected with the receiver, as much air as possible is extracted from it, and from the yarn contained in it. The size is then introduced into the receiver from another vessel by means of a pipe: in this pipe is inserted a cock, which prevents the size from entering the receiver before the air is extracted; and when the air is extracted, the size is admitted by turning the cock. When the size is admitted into the receiver, it enters into the yarn, and impregnates it very rapidly. The size answers best when made thick, and introduced into the receiver at, or nearly at, the boiling temperature. The process may be facilitated by heating the yarn to any degree of heat not exceeding that of boiling water.

Although the patentee gives a particular description of the process which he uses in sizing cotton yarn, he confines his invention to the extraction of the air from a vessel containing the cotton yarn, and consequently from the yarn itself, and applying the size to the yarn while the air is so extracted.

Mr. MARSLAND'*s Patent for an Improvement in the Process of Dyeing. Dated July* 1805.

THIS improvement is merely another application of the same principle upon which Mr. R.'s improved process for sizing cotton yarn is founded, and consists in the extraction of the air from a vessel containing the substances to be dyed, and applying the dyeing materials to them in a liquid state, while the air is so extracted from them.

END OF THE FIRST VOLUME.

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